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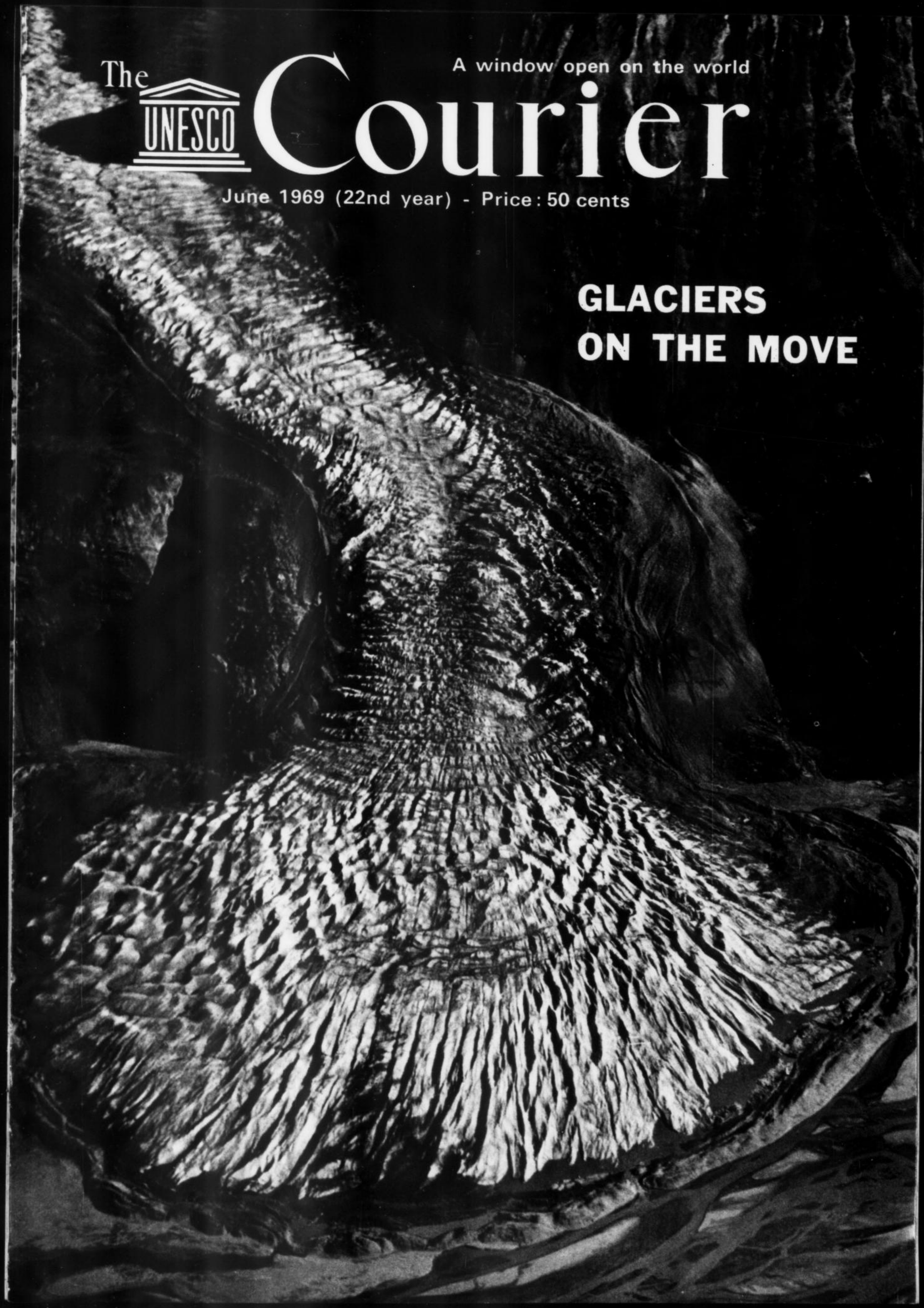
GLACIERS ON THE MOVE



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TREASURES OF WORLD ART

35

Goddess on a silver cauldron

In 1891, a magnificent silver cauldron of Celtic workmanship was unearthed from a marsh at Gundestrup, in Jutland (Denmark). Its inner and outer surfaces were richly ornamented with embossed figures: a sacred bull, legendary animals, horsemen, warriors, musicians and numerous divinities, including Cernunnos, the horned god of the Celts. The cauldron was probably used in religious ceremonies and dates from the end of the Celtic expansion in Europe some 2,000 years ago. Among its decorative motifs whose style reflects a mixture of Celtic art and oriental and classical influences is this figure, believed to represent a goddess-mother.

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Cover photo

More than one-tenth of our land surface is permanently covered by ice. Utilization of even part of this enormous reserve of "solid" water would solve the growing world shortage of fresh water. But can we accelerate the melting rate of certain glaciers without disturbing their normal regime with possible unforeseen effects? This is one of many problems which scientists are studying in the glaciological research programme of the International Hydrological Decade (see article page 16). Here, a giant glacier flows into the sea at the head of a Greenland fjord (see also photo centre pages).

Photo © Ernst Hofer (from "Arktische Riviera", Ed. Kümmerly and Frey, Berne)

THE NEW WORLD OF THE OCEANS

by Daniel Behrman

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As the ocean thrusts itself into our affairs, it creates situations that demand new political and juridical answers. Its present and future uses are incompatible with the old assumption that beyond the three-mile limit it belongs to no one. For all intents and purposes other than navigation, the assumption is as anachronistic as the shore batteries upon whose range the limit was based. At least seven nations have claimed jurisdiction over fishing rights 200 miles off their shores.

Under the Convention on the Continental Shelf, adopted by a United Nations conference in 1958 at Geneva, all coastal nations now have a clear title to the bottom resources of their continental shelves down to a depth of 200 metres (656 feet), a boundary that can run as far out to sea as 250 miles, depending on the hazards of submarine geography. It is as if a continent larger than Africa were added to their area.

Within it, states the Convention, they own "the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move, except in constant physical contact with the seabed or the subsoil."

Certain "organisms" slip through this legal barbed-wire entanglement. In international disputes since the adoption of the convention, marine biologists have been drafted as experts to determine whether lobsters and king crabs swim or crawl. If the animals swim, then the lawyers must consider them as fish and anyone can catch them ; if they crawl, they belong to the owner of the continental shelf.

Ownership of the shelf is not all that clear, either. In 1958, the Geneva Convention's framers expected that twenty years would go by before anything worthwhile could be mined beyond the depth boundary of 200 metres that they had drawn.

Oil drillers are already capable of surpassing it; the miners of phosphorite and manganese nodules are waiting in the wings. They can make use of a purposely opened loophole in the convention's definition of the continental shelf as "the seabed and subsoil of the submarine areas adjacent to the coast . . . to a depth of 200 metres, or beyond that limit, to whether the depth of the superjacent waters admits of the exploitation of the natural resources of the said area."

In other words, exploitation of the natural resources is nine points of the law. Dr. Kenneth O. Emery, a geologist from Woods Hole Oceanographic Institution, Cape Cod, U.S.A., is among those who note that "exploitation" is not defined in the convention.

He has asked several provocative questions that cannot as yet be answered: "Does the recovery of a few manganese nodules as curios constitute exploitation? How many tons of nodules per year per unit area constitutes exploitation? Is profit on a free and open market required, or will large governmental subsidies substitute for profit? Manganese nodules with their content of cobalt, copper and nickel are the chief deep-sea resources that

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DANIEL BEHRMAN *writes on science for Unesco's Press Division. While on leave from Unesco, he authored "The New World of the Oceans", to be published this month by Little, Brown and Co. in Boston. The above article is taken from the chapter "The United Oceans" and is reprinted by permission of the author who holds the copyright, and the publisher. Mr. Behrman, an American ex-newspaperman, has written extensively on Unesco field projects.*

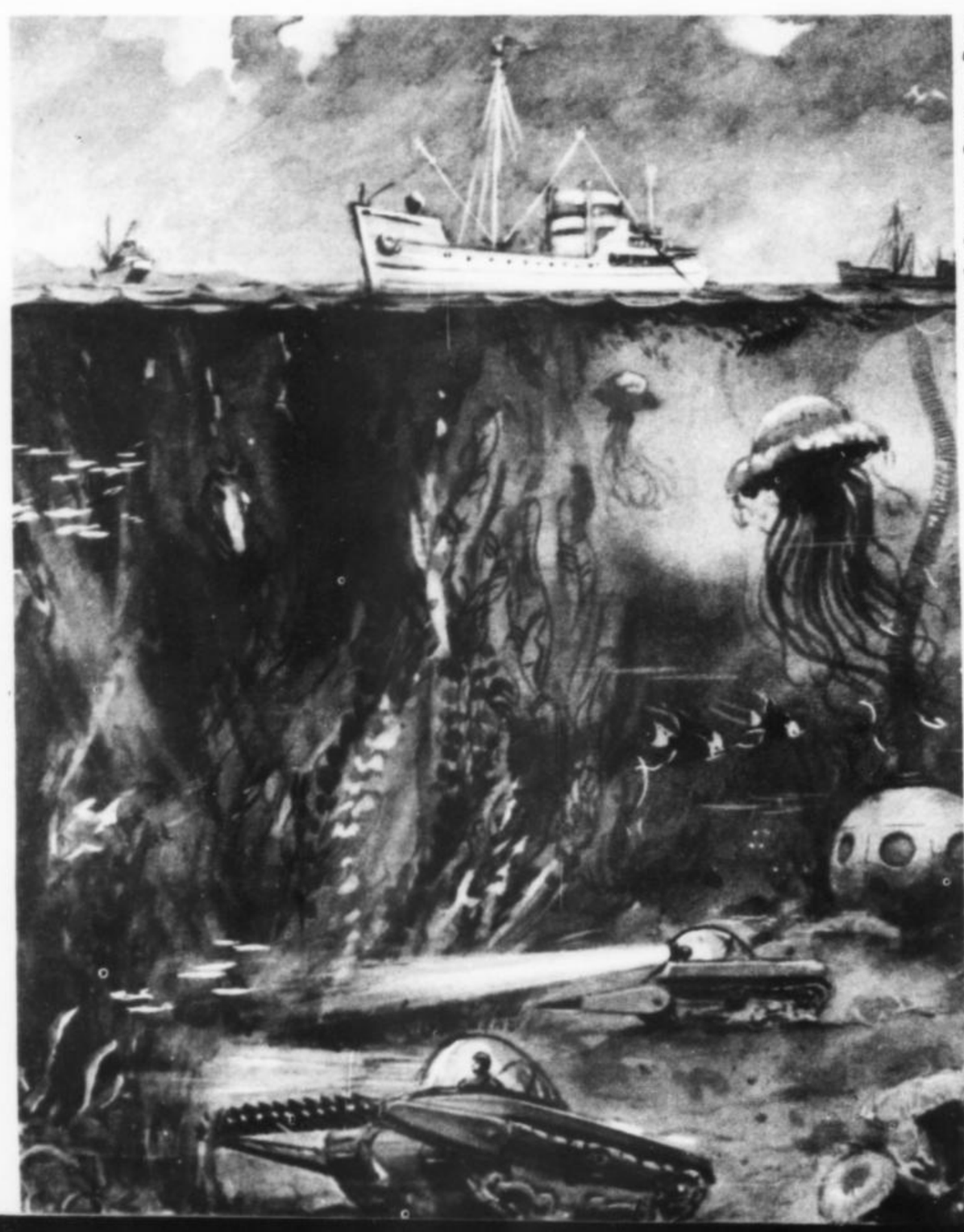

Photo © Science Service, Paris

This hollow-eyed face, right, is actually a greatly enlarged view of the pores and spine base of a species of zooplankton. As all sea life depends on this mass of minute drifting plant and animal organisms, analysing the microscopic life in the oceans has become an increasingly important part of the science of oceanography. Scientists foresee the day when "prairies" of the deep will be harvested, with stocks of fish being herded and grazed as a farmer herds cattle. Left, artist's impression of future submarine "reapers" clearing a forest of seaweed which obstructs fishing operations.

Photo © Allan W.H. Bé. Lamont Geological Observatory, New York

No flags on the sea floor

generally receive mention, but does the recovery of a few million dollars worth of these metals per year warrant assignment of sovereignty to huge areas of the earth?"

There are other questions. What is the status of the country with a deep trench near its coast that separates it from what would normally be its continental shelf? Norway was in such a position when drilling rights were apportioned in the North Sea, but Great Britain allowed her to extend her claim across the trench.

In the Pacific Ocean, the long arm of American law reached over waters 10,000 feet deep to prosecute an ingenious group that had tried to put a man-made island on Cortes Bank, 110 miles off San Diego, to reap a crop of abalone and lobster. To start their island, they decided to sink an old troopship on the bank, but their plans went awry and the ship was wrecked in 35 feet of water. They were charged with creating a hazard to navigation on the continental shelf off California.

THE convention's least controversial provisions are already becoming obsolescent. It declared as a matter of course that the legal status of the seas above the shelf remains unaffected. Serious doubts are now being expressed about allowing freedom on the top of the sea.

Dr. John P. Craven, chief scientist of the Navy Special Projects Office in Washington, does not see how fishing and shipping could continue in areas where divers are working for long periods at a stretch:

"They are in a precarious position with respect to man-made perils. They cannot tolerate explosive detonation in their near vicinity; they cannot tolerate extensive pollution; they cannot tolerate interference by trawls or dragnets."

Such prospects are plausible in the context of a legal vacuum. There is a growing sentiment that the vacuum cannot be allowed to exist much longer if we are not to repeat in the ocean the same grievous mistakes that have left us in our present predicament on land.

In July 1966, President Johnson said what many are thinking: "Under no circumstances, we believe, must we ever allow the prospects of rich harvests and mineral wealth to create a new form of colonial competition among the maritime nations. We must be careful to avoid a race to grab and to hold the lands under the high seas. We must ensure that the deep seas and the ocean bottoms are, and remain, the legacy of all human beings."

In several quarters, the President has been taken literally. Senator Claiborne Pell, of Rhode Island (a state, as he has said, with 156 of its 1,214 square miles under water and a shoreline of 384 miles) introduced into the U.S. Senate, in September 1967, a short resolution aimed at achieving "a reasonable legal order for the extra-national world ocean."

The resolution speaks of an "urgent need" for an international agreement to keep the deep-sea floor and its resources free for use by all nations. The agreement would also ban the stationing on the ocean bottom of "unproven types of nuclear or other kinds of mass destruction weapons."

Pell asked that the U.S. State Department take steps leading to an ocean space treaty that would allay any fear that the United States and the Soviet Union "might attempt to carve up the oceans of the world into co-dominions much as the Spanish and Portuguese sought to do with the New World in their agreement at Tordesillas, signed on June 7, 1494."

Just about this time, Malta, a state even smaller than Rhode Island, dropped a similar idea into the United Nations General Assembly. In August 1967, Malta requested that the Assembly's agenda be modified to include an item on "the reservation exclusively for peaceful purposes of the seabed and of the ocean floor, underlying the seas beyond the limits of present

CONTINUED ON PAGE 8

THE UNDERWATER LANDSCAPE OF OUR PLANET

Beneath the enveloping mantle of the oceans lies most of the geography of our planet, a landscape as seamed and rugged as any on earth. Until recently, man knew even less about the submerged 70 per cent of the earth's surface than he knew about the near side of the moon. Today with the aid of new electronic instruments man has mapped the ups and downs of much of the sea bottom. One striking result is this map of the Atlantic Ocean floor (detail of a larger map) reproduced here by special permission of the National Geographic Society, Washington (U.S.A.).
Map shows how the Continental Shelf, a vast underwater platform, juts out from the coasts of North America, Greenland, Iceland, Europe and Africa. Deep gorges and canyons, crevasses and valleys mark the greatest depths. Winding down the middle of the ocean from Iceland towards the equator is the Mid-Atlantic Ridge, an immense oceanic "spinal cord", criss-crossed by deep fractures and flanked by chains of high mountain ranges. Key to figures shown: -12,000, depth in feet below sea level; *(14,000)*, height above the 16,000-foot average depth in the abyssal plains; 9,000, height in feet above sea level on islands and continents.

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270,000,000,000 tons of heavy water

national jurisdiction, and the use of their resources in the interests of mankind."

In an accompanying memorandum, Malta suggested that the "net financial benefits" that would come from use of the sea floor should be used "primarily to promote the development of poor countries." An international agency could be created to assume jurisdiction over the ocean floor as a trustee for all countries.

One of the main proponents of such a solution has been Dr. Francis T. Christy, Jr., of Reseach for the Future, Inc. in Washington, a non-profit corporation financed by the Ford Foundation. Christy discounts the feasibility of simply extending each country's continental shelf as it is exploited.

Under such a "national lake" approach, the French and the British could lay claim to vast areas of the Pacific, Atlantic and Indian Oceans because of their island holdings (the Geneva Convention gives islands the same rights as the mainland). The Soviet Union, with its comparatively small coastline, would be short-changed and, Christy remarks, no ocean regime can be set up without its agreement.

The second possibility he mentions is that of the "flag nation". Anyone could operate on the ocean floor under the protection of his own country but competition and conflict would inevitably call for supra-national rules anyway. Christy concludes that the answer is an international authority that could collect royalties from the the seabed miners in the deep ocean, and in return guarantee their exclusive rights to a deposit.

THE U.N. General Assembly started to discuss Malta's idea in November 1967. Dr. Arvid Pardo, the Maltese delegate, provided more details about the international agency that his government had in mind. The ocean floor, he believed, could not very well become the responsibility of the U.N. in its present form: "It is hardly likely that those countries that have already developed a technical capability to exploit the ocean floor would agree to an international regime if it were administered by a body where small countries, such as mine, had the same voting power as the United States or the Soviet Union."

Pardo suggested a new agency that could finance itself by income from rental of the ocean floor. If the agency were created in 1970, its gross income could reach $6,000 million a year by 1975, a sum that could be transfused into the underdeveloped world. Two months later, the General Assembly adopted its resolution setting up a committee of thirty-five countries to study the item in view of future action.

Malta's suggestion kicked up a curious storm in the United States. Strong reactions were heard in the halls of Congress against the idea of turning the sea floor over to the United Nations (which Pardo specifically said he did not have in mind). Florida seems to have led the attack.

One of the state's congressmen, Representative Paul G. Rogers, proposed an eastward ho! alternative. He urged that the United States should occupy the sea floor out to the Mid-Atlantic Ridge by 1980. "The sea bottoms off the United States present an opportunity to expand our national borders in the same manner we did as we crossed the West in the early days."

In October 1967, Florida's governor, Claude Kirk, went down in the underwater research vessel *Aluminaut* and planted the flags of his state and the United States on the bottom, eight miles off Miami, at a depth of 1,000 feet. When he came up, he explained to the press: "I didn't make a fanfare about this thing because we would have had eighteen senators and the federal government protesting. Well, it's too late now. You should dismiss the question of boundaries when talking about the ocean bottom. It is only a question of possession. That's the way the Spaniards did it. They just said 'it's mine' and took it. The United States should do the same."

Eighty-six members of Parliament for all British parties do not see things his way. In May 1968, they tabled a motion in the House of Commons that asked, as Pell had done in the U.S. Senate and Malta in the U.N. General Assembly, for a treaty to conserve the sea floor as "the common heritage of mankind."

Elsewhere, it has been hinted that the strongest backers of the Malta plan were large companies with a stake in the sea. Their support was attributed to their business sense, not to a sudden infatuation with the U.N.

Yvonne Rebeyrol, who covers oceanography for *Le Monde* in Paris, wrote: "They [industrial firms] are the most eager of all to see a settlement of the legal problems raised by the exploitation of the resources of the ocean bottom. In fact, they cannot start to invest heavily on the bottom until they are certain they will not be evicted by someone else who, for example, could claim prior discovery or rights under a national law."

The debate among parliamentarians, economists, jurists and diplomats shows that the land world is becoming aware of the built-in internationality of the ocean. The oceanographers are involved in dozens of international organizations, the oldest being the International Council for the Exploration of the Sea that dates back to 1901, when it was founded in Copenhagen by countries of north-western Europe.

Dr. Arthur Maxwell, associate director of Woods Hole, has gone so far as to say that "the oceanographers have arrived at a position where they are actively considering a public order of the sea quite independently from the efforts taking place in international law circles."

Maxwell, who is equally at ease at sea or in a U.N. working group, traces the first major co-operative effort in oceanography back to the International Geophysical Year, which ran through 1957 and 1958. It was based on enlightened self-interest: "While the motivation of the organizers of this effort was co-operation on a world-wide basis, its acceptance among the oceanographic community was at least in part an economic necessity. Support for oceanography had been fluctuating widely and this international programme provided a salvation."

The scientists then convinced their foreign ministries to support an Intergovernmental Oceanographic Commission, which came into being under Unesco's wing in 1960, with the late Anton Bruun, a Danish deep-sea biologist, as its first chairman.

ONE of the Commission's earliest moves was to turn all its members' guns against a proposed international research vessel. The oceanographers knew what they were doing. Instead of one ship performing international research, they have since had dozens—their own. The Commission offers them a way to combine their resources, represented by land laboratories as well as by ships.

Such resources are not the monopoly of a single country. The United States, it is generally agreed, spends more than anyone else on the ocean. Its federal marine science and technology budget has been growing lustily: $333 million in the 1966 fiscal year; $409 million in 1967; $447 million in 1968.

The proposal for fiscal year 1969 was $516 million, an increase of 15 per cent, but still only 3 per cent of the $17,000 million that the federal government devotes to research and development. In 1967, the United States had 125 oceanographic ships.

In a report to the U.N., the U.S.S.R. has stated that its annual expenditures on oceanography run to $20 million and that it operates 110 vessels. Comparisons are difficult to establish and

are always being made. In the United States, there is a tendency to speak in public about "catching up with the Russians" whenever funds are being sought. American oceanographers who visited the U.S.S.R. have told me that their Soviet colleagues tend to use the same argument for the same purpose.

There is certainly a similarity in attitudes about the sea. The following quotation must sound familiar to Western readers: "More than 40 chemical elements have been discovered in sea water. There are more than 10 billion tons of gold, four billion tons of uranium and 270 billion tons of heavy water [the author uses "billion" in the U.S. sense, 1,000 millions] to say nothing of the fact that the sea contains 97 per cent of our planet's wealth in water. The ocean is a storehouse holding all the minerals of the globe. If they were gathered and spread evenly over the earth's surface, they would form a layer more than 200 metres thick."

It is from an article entitled "Seven Seas," by A. Grinevitch, in *Yuni Technik* (Young Technician), a popular Soviet science magazine aimed at young readers. The issue also contains articles on the polar seas, whaling, ships of the year 2000 and a piece by Jacques Cousteau, who starts by telling *Yuni Technik's* audience: "Mystery is a challenge I cannot resist."

There is a difference between the usual Western presentation of the subject and the Russian approach: Grinevitch talks of six seas (those of the physicists, the biologist, the geologist, etc.), and adds a "poet's sea." A Soviet captain describes an area in the Mediterranean: "A handful of amber beads is scattered over the blue Aegean. Garlands of yellow pebbles fill the waters between the Greek and Turkish shores; their many rows cross the sea, and along the southernmost strand of the necklace of islands, there hangs the mysterious amulet of Crete."

To learn more about Soviet oceanography, I called on an old acquaintance, Dr. Konstantin N. Fedorov, a physical oceanographer from Leningrad who worked for the Institute of Oceanology of the U.S.S.R. Academy of Sciences. He now doubles in brass as head of Unesco's oceanography office and secretary of the Intergovernmental Oceanographic Commission (and manages to do valid scientific work during his weekends). No interpreter was needed: Fedorov's English is as fluent as his Russian, and his French is not far behind.

He thought that American and Soviet oceanographic efforts are now running parallel, though at their very origin they stemmed from different sources: the practical needs of the seaman and the fisherman in the United States, and basic scientific curiosity in the U.S.S.R. "During the eighteenth and nineteenth centuries, attempts were often made to study the ocean as part of Russia's major geographic exploratory efforts. The great Russian scientist-explorers were always assured the active support of the Academy of Sciences. Ever since its creation by Peter the Great, the academy has never been a passive club of academicians."

A major stimulus to Soviet oceanography was the early exploration of the Arctic. "Little is known outside Russia of the dramatic history of the Arctic seas. They were our only free route to the Pacific: to Japan, to the Aleutians, and to Alaska, our source of furs and gold. Beginning in the seventeenth century, Russian explorers went east along the Arctic coast in summer. This economic drive was the basis of our present efforts in Arctic meteorology and oceanography. On the northern route, the U.S.S.R. runs one of the few existing oceanographic services in the world. It serves shipping bound from Archangel and Murmansk to Vladivostok."

Fedorov himself came into oceanography through meteorology. In 1947, he graduated from a technical college in his native Leningrad with the diploma of meteorological observer. "Our diplomas are narrowly specialized, true, but they are based on a very broad education. The technical college also offered a course in descriptive and physical oceanography. It interested me, and I chose it for my higher education and more advanced work for my Ph.D."

His first expedition took him to the Baltic and the Barents Seas. Later, he worked in the Black Sea and the Pacific, and in 1959, he was chief scientist aboard the *Akademik Vavilov* when she made the first Soviet research expedition to the Mediterranean. Following that trip, he went to England to study at Liverpool University and the Imperial College of Science and Technology in London on a Unesco fellowship.

FEDOROV has also sailed on an American ship, Woods Hole's *Atlantis II*, during the International Indian Ocean Expedition in 1965. This cruise—his idea of a vacation from his office in Paris—gave him an opportunity to work with Henry Stommel, an American oceanographer, on the study of differences in temperature and salinity over depth ranges of only a few feet—the new field of micro-oceanography.

He knew of Stommel from his writings. "His works were among the first scientific books that I studied in English. Practically every research oceanographer in the Soviet Union reads English. Later, I met Stommel at a meeting of our Commission's scientific advisory group in Moscow. He is one of those scientists—I only know a few—like Lev Zenkevich, the father of marine biology in the Soviet Union, or Roger Revelle, or Vsevolod Zenkovich, the coastal geomorphologist, or Walter Munk—who have both stature and unlimited human qualities." Stommel and Fedorov published a joint paper on their research.

Fedorov saw no difference between *Atlantis II* and Soviet vessels in the organization of work at sea and the spirit in which it was carried out. "On both American and Soviet ships, many crewmen participate voluntarily in scientific observations: bird-watching or surface fish-catching. When one of our ships is on station at night, sailors lower a lamp into the water and catch fish. It's a sport, of course, but they don't eat the fish. They give them to the scientists for their collections. I think that, like *Atlantis II*, we get the type of sailor

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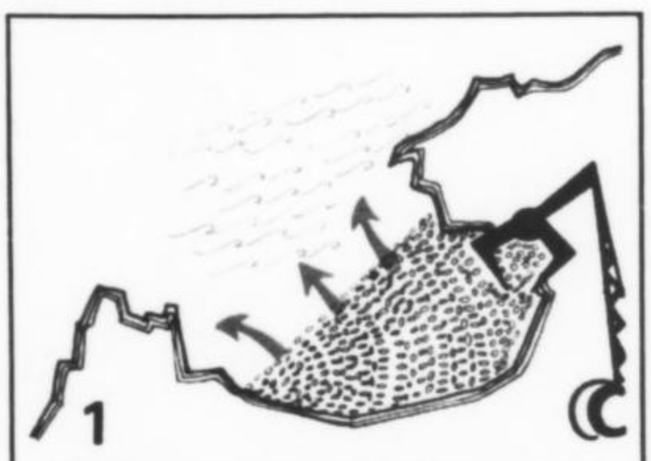
MINING SEAFLOOR URANIUM

Century after century, water washing off the land has deposited in the oceans every mineral known to man. Scientists are now devising new ways to "mine" the ocean's uranium which totals four billion tons. Drawings below explain the functioning of a huge "uranium trap" to be set up on the coast of North Wales.

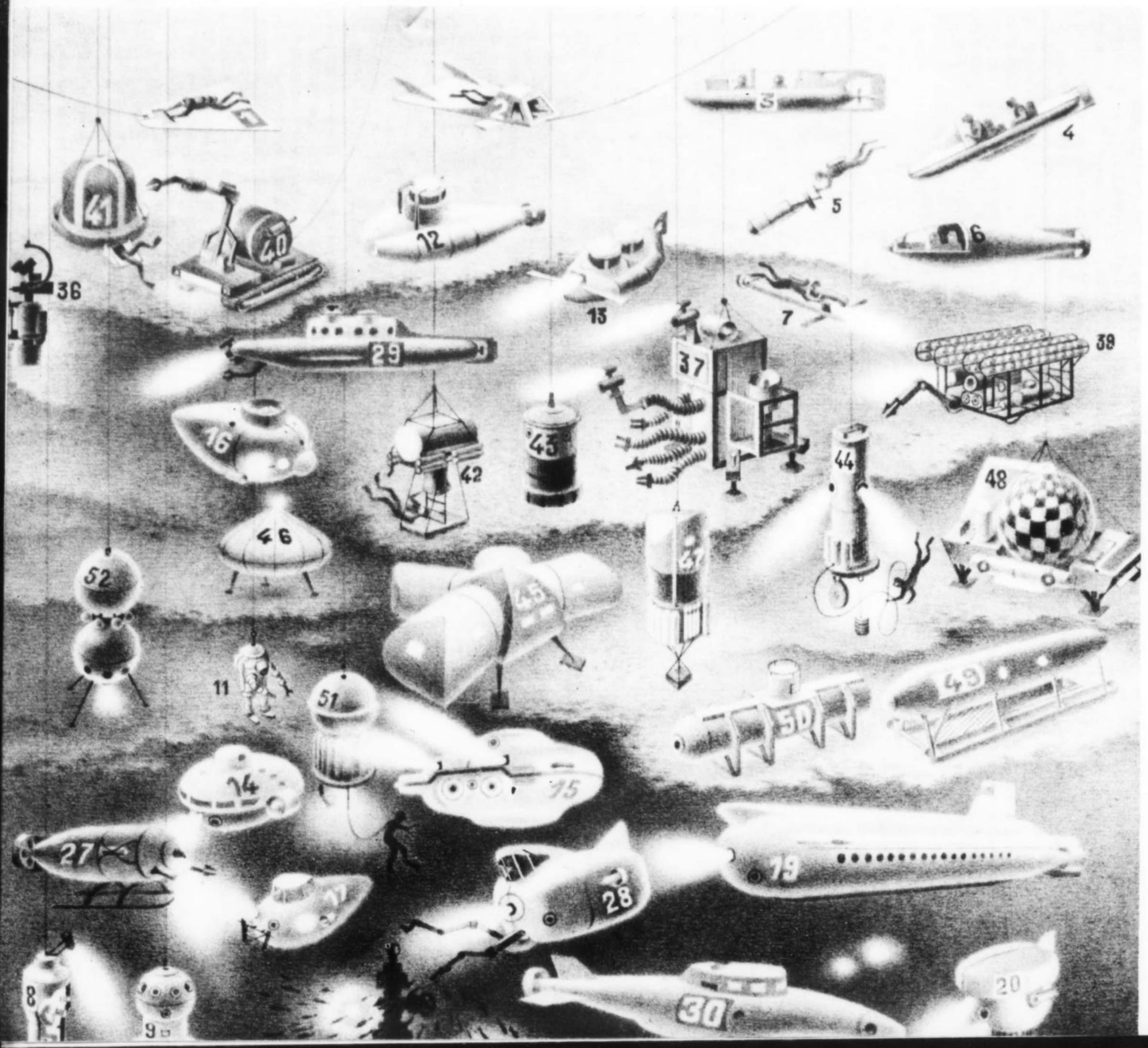


Nodules of titanium hydroxide, a "magnet" for uranium, are placed on the beach at low tide.

The rising tide covers the nodules. A barrage is placed across the bay to trap the seawater.

Two days later the barrage is removed. Nodules, on which uranium has combined with the titanium hydroxide, are recovered at low tide.

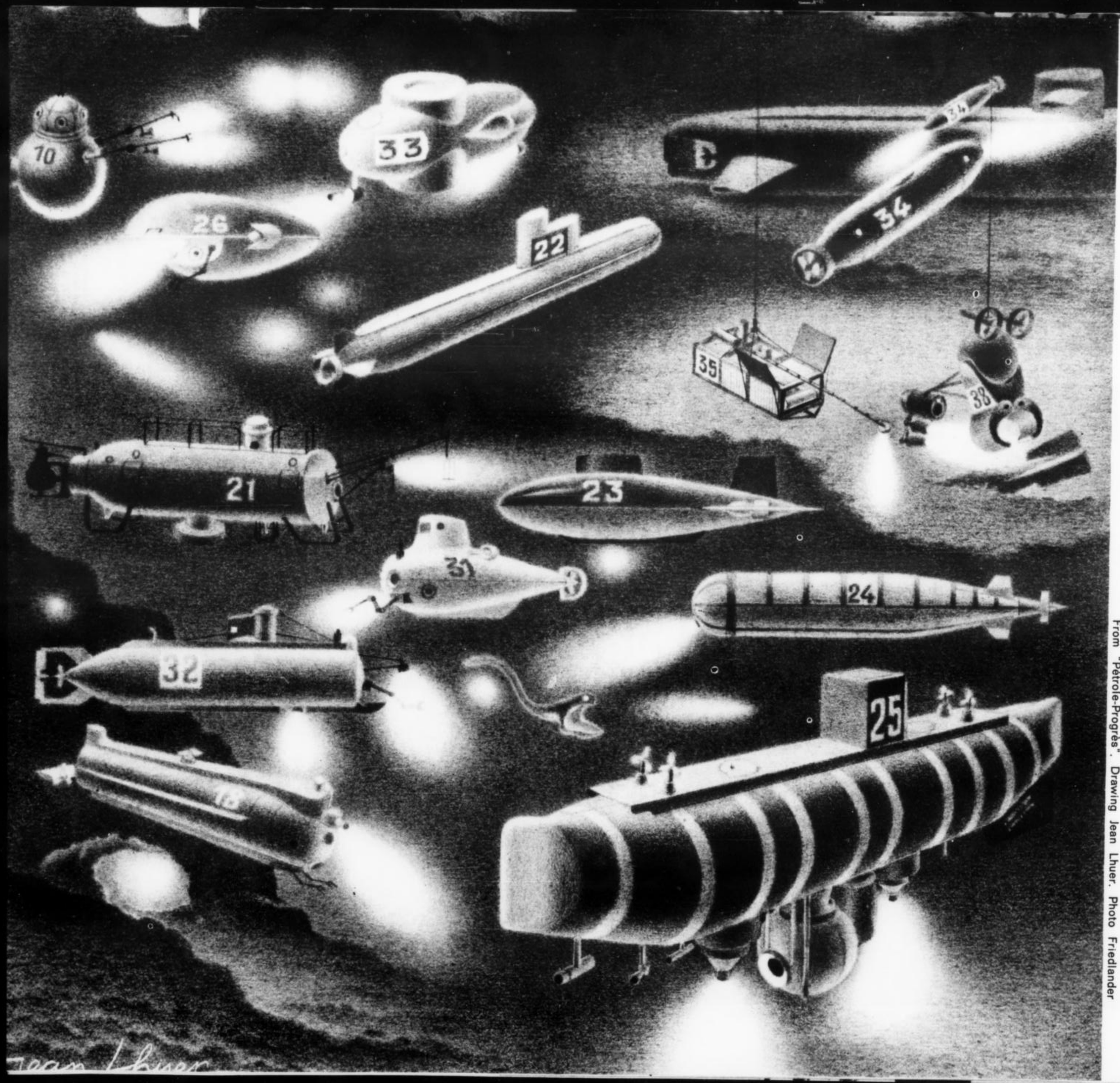
Photos © Science Service, Paris



For aquanauts of inner space

To explore the ocean depths—the still mysterious "inner space" of our planet—scientists and engineers have designed and built a formidable array of vehicles, from underwater gliders to deep-diving submersibles. On this double page we show a broad selection of these unique devices of oceanographic research. These vehicles have been built by Belgium, France, Italy, Japan, U.K., U.S.A., U.S.S.R. and Switzerland. The maximum operating depth of each vessel shown here is given in metres, abbreviated m.

1. *Manta* underwater sled, 30 m.
2. Sub-aquatic glider, 30 m.
3-4. Two-man submarines, 30 m.
5. *GRS* marine scooter, 30 m.
6. *X-engine,* 2 men, 30 m.
7. One-man *DSV* scooter, 30 m.
8. One-man diving turret, 600 m.
9. One-man *Galeazzi* diving turret, 600 m.
10. *Barton* sphere with manipulating arms, one man, 1,400 m.
11. *J.S. Peress* heavy diving suit, 200 m.
12. *American Submarine 600,* 2 men, 200 m.
13. *American Submarine 300,* 2 men, 100 m.
14. *Pisces* vehicle with mechanical arms, 2 men, 1,500 m.
15. *Diving saucer* with mechanical arms, 2 men, 300 m.
16. *Benthos V* observation vehicle, 2 men, 200 m.



17. *Star II* research vehicle, 2 men, 200 m.
18. *Aluminaut* deep submersible, 5-6 men, 5,000 m.
19. Piccard *Mesoscaph,* 40 passengers, 800 m.
20. *Deep Jeep* observation vehicle, 2 men, 600 m.
21. *Kuroshio II* fisheries research vehicle, 4 men, 200 m.
22. *Dolphin* acoustic and oceanographic research vehicle
23. *Deep Quest,* exploration vehicle, 4 men, 2,000 m.
24. *Moray TV 1 A,* deep research vehicle, 2 men, 2,000 m.
25. *Bathyscaph Trieste I,* deep research vehicle, 2 men, 12,000 m.
26. *Deep Star 4000,* research vehicle, 3 men, 1,300 m.
27. *General Mills* submersible (designed but not built)
28. *Beaver* submersible to service underwater oil wellheads, 2 men, 200 m.
29. *Perry Cubmarine* with mechanical arms, 2 men, 200 m.
30. *Star III* observation vehicle, 2 men, 600 m.
31. *Alvin,* first operational scientific research submarine, 2 men, 2,000 m.
32. *Yomuri,* fisheries research vehicle with manipulators, 6 men, 300 m.
33. *DOWB* research and deep ocean engineering vehicle, 2 men, 2,200 m.
34. *DSSP* submarine rescue vehicle, 1,000 m.
35. Underwater photographic device, towed observation robot, 1,500 m.
36. *Mobot,* for oil drilling; hears, sees, swims, turns screws and handles tools, 100 m.
37. *Unamo,* multi-task robot with auxiliary engines, 100 m.
38. *Solaris,* robot for locating and retrieving objects, 1,500 m.
39. *Télénaut,* cable-controlled research vehicle, with mechanical arms, 1,000 m.
40. *GMI-RUM* cable-controlled, tracked vehicle for collecting seabed samples, 3,000 m.
41-42. Inflatable diving bells for aqualung divers; *Sea Igloo* (50 m.), *SPID* (100 m.).
43-44. *Galeazzi* turret and *Sea Diver* bell, equipped with air lock, bases for aqualung divers, 150 m.
45. *Etoile de Mer (Pré-continent 2),* seabed base for aqualung divers, 30 m.
46. Diving saucer garage *(Pré-continent 2),* 30 m.
47. Underwater cabin *(Pré-continent 2),* two men, 50 m.
48, 49, 50. Seabed bases for aqualung divers; *Pré-continent 3* (60 m.), *Sealab I* and *II* (80 m.)
51-52. *Ocean System* and *Purisima* diving bells with air-locks, 150 m.

From "Pétrole-Progrès". Drawing Jean Lhuer. Photo Friedlander

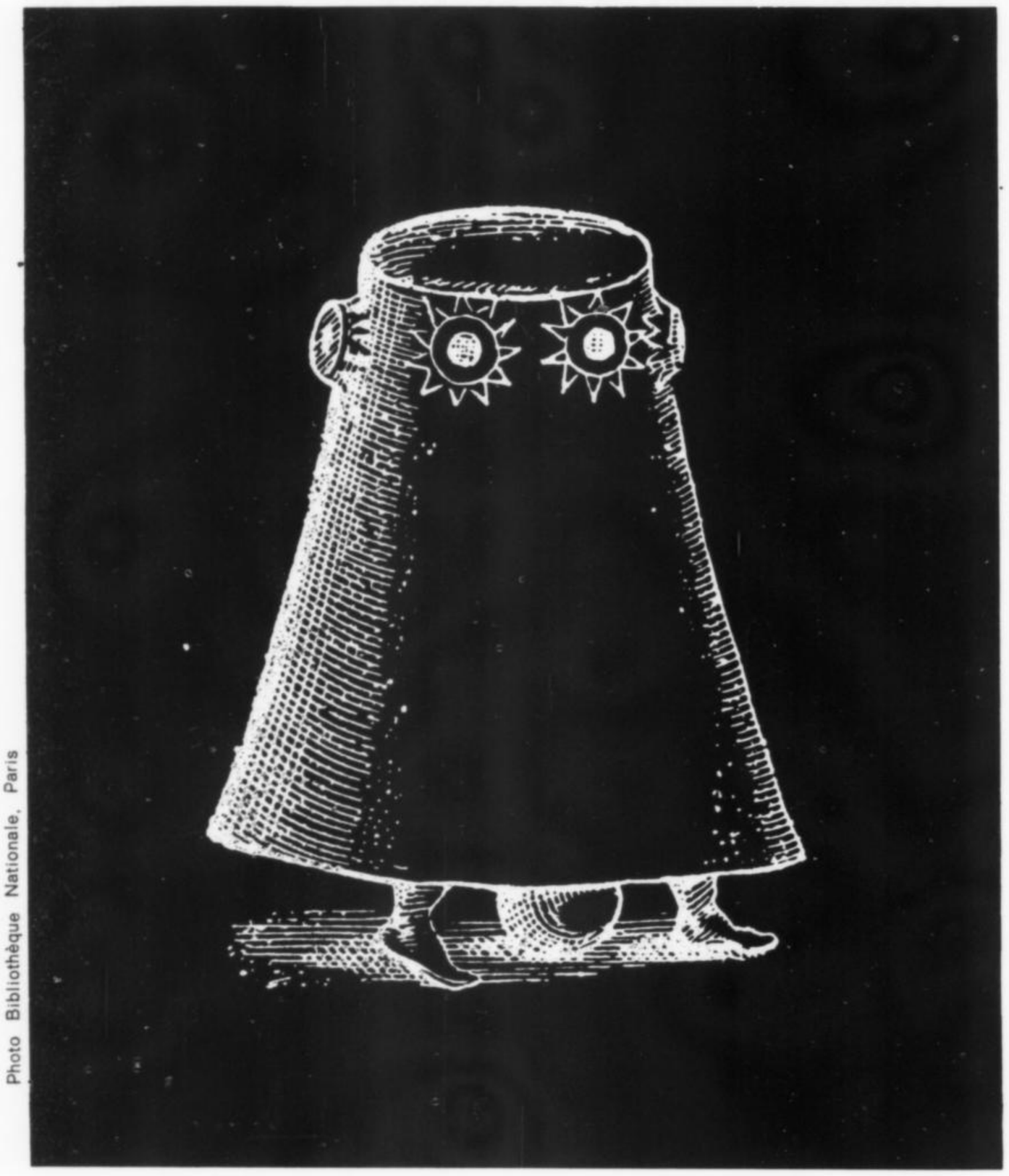


Photo Bibliothèque Nationale, Paris

According to legend, Alexander the Great, in the 3rd century B.C., was lowered into the sea in a glass barrel "to see what was there and to defy the whale" (from a 15th century manuscript, below). Leonardo da Vinci designed submarines and diving gear and is said to have made a descent in a diving bell. Above, a 17th century one-man diving bell, ballasted by a large lead ball. Water penetrated the bell to the point where it equalized the air pressure.

Mobile houseboat for

who doesn't go to sea just for the money."

I asked Fedorov a question that keeps popping up: why are Soviet research ships so big. The largest is the veteran *Ob*, displacing 12,000 tons, and several newer vessels run to 6,000 tons, three times the size of *Atlantis II*. "There are several reasons. The boundaries of the U.S.S.R. are such that our ships cannot keep returning to Soviet ports. It is not profitable for them to pay for supplies in foreign ports. Fuel, for example, is much cheaper at home. So voyages must be long. A large ship offers more comfort for the scientific team and much more of a cultural life for both the scientists and the crew."

Fedorov confirmed what I heard from American visitors to the Soviet Union who were struck by a solid emphasis on details in oceanographic work. "We're very pedantic in scientific work. When we make observations, we bring along not only great scientists but a host of intermediate characters. They take a student by the ear and they give him a smack if he is careless. This is an absolute must, from the point of view of methodology. You must enforce standards of observation when you deal with a changing environment—otherwise, your measurements will change more than the environment."

Marine science in the U.S.S.R., he explained, has three main bases: the Academy of Sciences, responsible for basic research in the world ocean; the All-Union Institute of Fisheries and Oceanography; and the Hydrometeorological Service, which provides forecasts for fisheries and shipping.

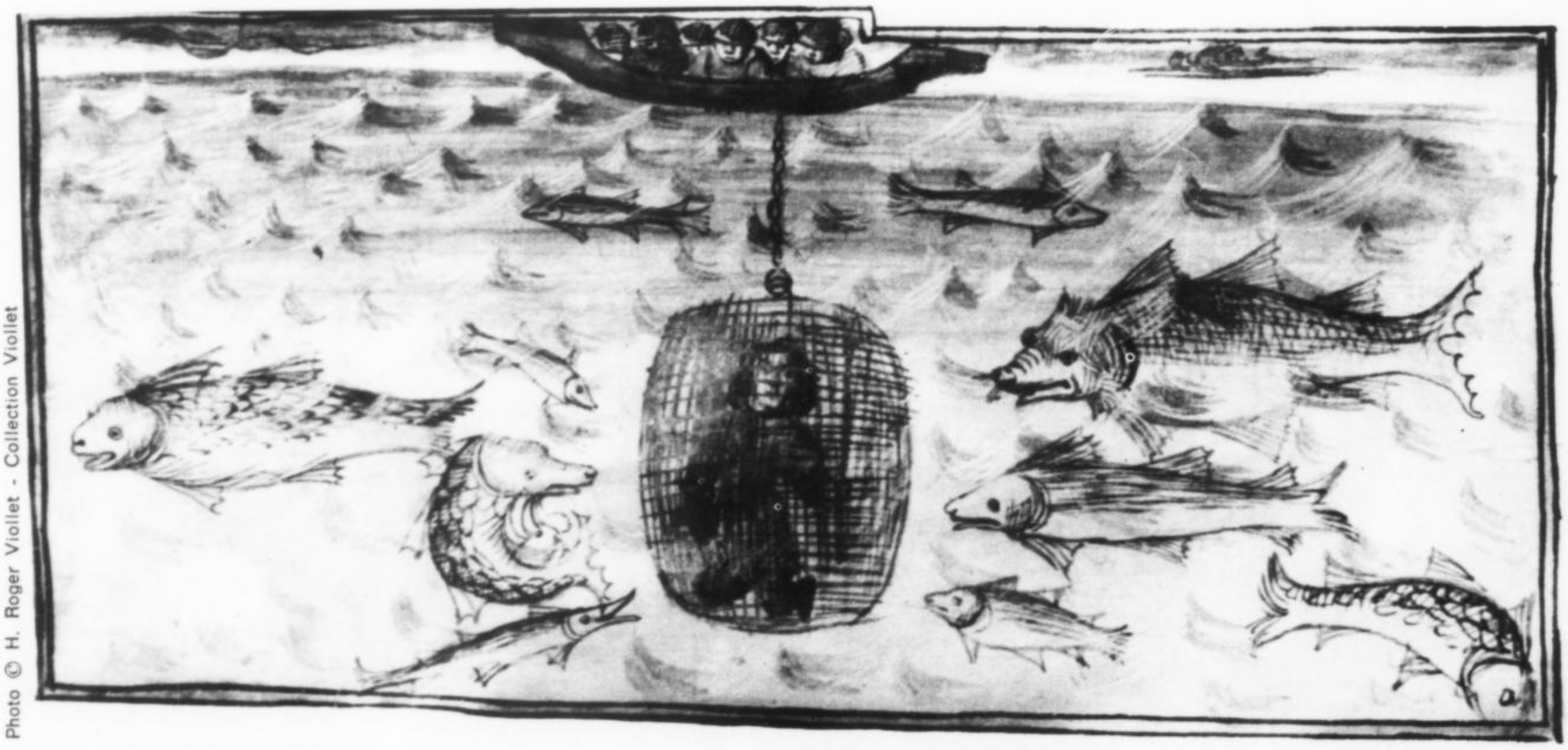


Photo © H. Roger Viollet - Collection Viollet

eep-sea divers

They are co-ordinated by a State Committee of Science and Technology under the Soviet Council of Ministers.

Fedorov, who never neglects a chance to score a point in the long and usually friendly debate that we have had over the years, reminded me that the U.S.S.R. brought the ocean into national affairs as early as 1921, when Lenin issued a decree establishing a "Floating Marine Science Institute" at Murmansk aboard a research vessel, the *Perseus*.

Behind the Soviet Union and the United States, money spent on oceanography falls off sharply, but there is no corresponding dip in quality. *Discovery* in Great Britain, *Meteor* in the Federal Republic of Germany, *Jean Charcot* in France are every bit the equal of American and Soviet ships, and laboratories are at the same level. Unlike space—a rich man's game—oceanography can be played by the moderately well-off.

TOTAL British expenditure on oceanography is less than $8 million a year, funded through a Natural Environment Research Council, which also finances activities in conservation, marine biology and Antarctic exploration.

The National Institute of Oceanography at Wormley in Surrey must get along on an annual budget of $1,800,000 that includes operation of the 2,800-ton *Discovery*. Frills are few and far between at the institute's laboratory, where offices are spartan and secretaries a collector's item.

There is no scrimping on the ship: she is fitted out as a small liner, on the theory that scientists get more work done when they live well. British oceanographers whom I met shuddered, when they recalled the steel decks of American vessels and the ordeal of going to breakfast without a cup of morning tea served in one's cabin by a cheery steward. *Discovery*'s size and comfort are considered an economy: she can work throughout the North Atlantic winter, and nothing costs more than a ship in port.

The Federal Republic of Germany is on pretty much the same tack as the British. The Ministry of Scientific Research pays the bills for the new $4-million *Meteor*, a magnificent 2,740-ton ship equipped with a dozen laboratories to work in all branches of oceanography. The German Research Society enabled her to carry out a notable cruise that studied both the geology and the inhabitants of seamounts in the North-East Atlantic, particularly the Great Meteor Seamount, a peak rising from a depth of 15,000 feet up to 900 feet and discovered by the first *Meteor* in 1938.

The cruise was led by another marine internationalist, Professor Günter Dietrich, head of the Institute of Oceanography at Kiel University. Dietrich was elected president of the International Association for the Physical Sciences of the Ocean in 1967 and he stuffs the *Meteor* with foreign scientists (on the seamount cruise, he had sixteen aboard from France, Great Britain, Norway, Portugal and Spain).

He once told a writer for *Science:* "When we were at the zero point of our existence in 1945, there was one commander who came as supervisor for oceanography from the British navy to our country. He did not come as a conqueror who drove the oceanographers in all directions . . . He gave them chances to work in Hamburg and Kiel . . . If oceanography revived in the Federal Republic of Germany, it was by his help. This was Dr. J.N.C. Carruthers of the National Institute of Oceanography."

A French government survey has counted 500 Frenchmen working in oceanography at no fewer than 100 laboratories. The statistic sums up the brilliant individualism that characterizes the French. While their country devotes but $26 million a year to all forms of marine science, they are present everywhere: whether in diving and underwater living, deep-sea tide measurements, biological studies in the deepest ocean with the bathyscaph *Archimède*, or the use of manned floating islands.

A National Centre for the Exploitation of the Ocean has been set up by the French government to harmonize these commendable, if somewhat disjointed, efforts. The centre operates the *Jean Charcot*, a new 2,200-ton ship, and is establishing a large oceanographic laboratory at Brest. As priorities, it has chosen the development of marine protein concentrates for food, aquaculture, the mapping of the continental shelf, deep-diving techniques, the prevention and cure of pollution, and air-sea interaction research.

It has contracted with Cousteau's Centre for Advanced Marine Studies at Marseilles for a new diving saucer that will take a pilot and two scientists

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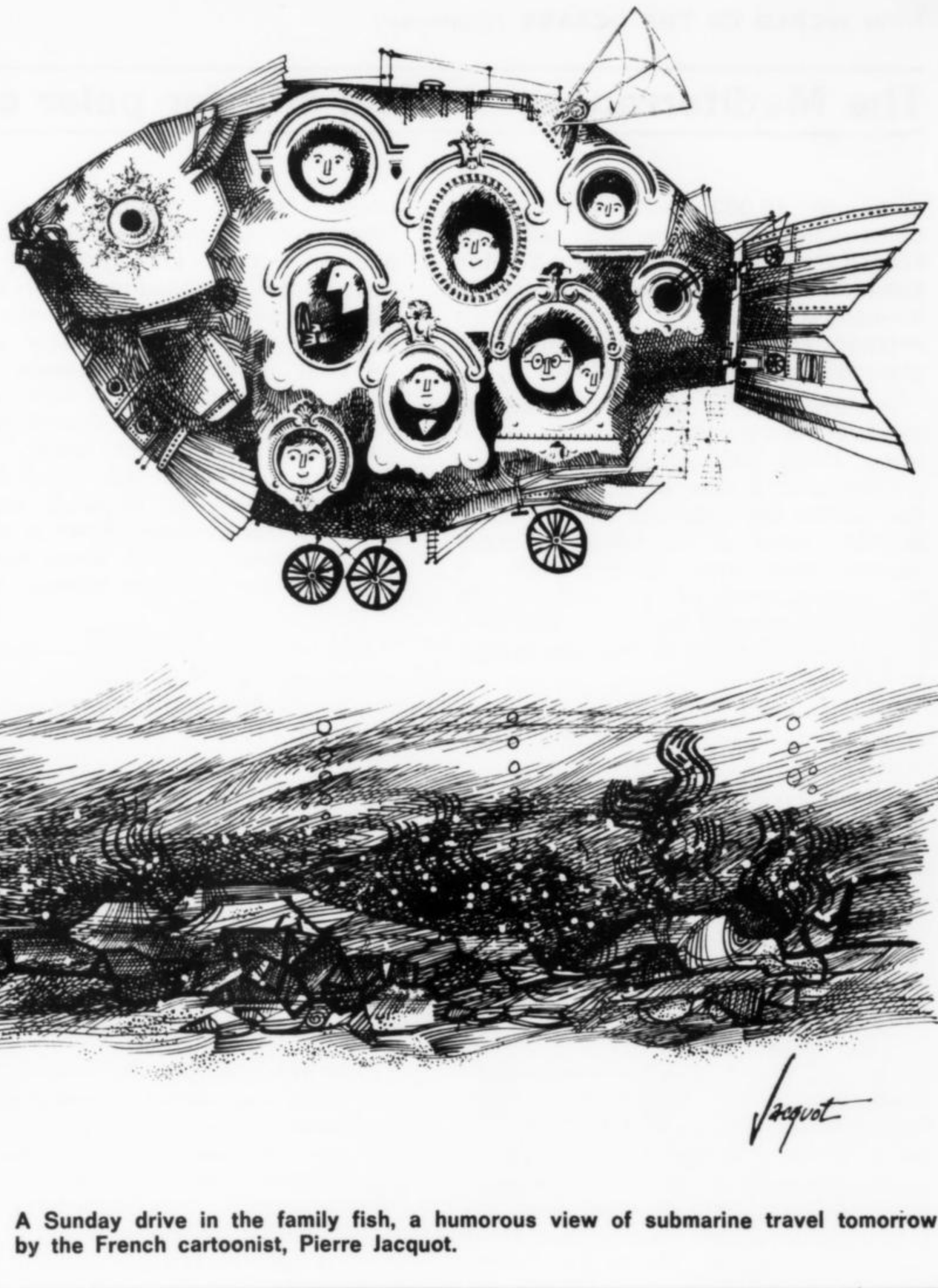

© "Telonde" (Thomson-CSF, Paris)

A Sunday drive in the family fish, a humorous view of submarine travel tomorrow by the French cartoonist, Pierre Jacquot.

The Mediterranean — ideal site for polar studies

down to 10,000 feet. Also under construction in co-operation with the French Petroleum Institute is a 230-ton submarine that is really a mobile houseboat for divers, rendering them independent of a surface ship and attendant risks of bad weather.

A new floating island will replace the first version that has been in the water since 1963 as a house sitting on top of 210 feet of pipe, with 160 feet below the waterline (it cannot be flipped; once it is down, it stays vertical even when it is towed). It has spent most of its working life anchored between Nice and Corsica, staying for as long as two years at a stretch.

Its main user has been the laboratory of Professor Henri Lacombe, who started the first modern course in physical oceanography in France in 1948. Members of Lacombe's staff, based at the Paris Museum of Natural History, take turns living on the buoy to run an ocean data station. They try to correlate what happens in the sea with the atmospheric records kept by meteorologists less than a hundred miles away.

"That is the advantage of working on air-sea interaction in the Mediterranean," Lacombe said. "It is caged by a network of land stations." To study these processes on a smaller scale, he is also creating a sample ocean 130 feet long, 10 feet wide and 3 feet deep, to be used with a wind tunnel. Professor Alexandre Favre, director of the Institut de Mécanique Statistique de la Turbulence at Marseilles, is in charge of this work.

Lacombe considers the whole Mediterranean as a miniature ocean where processes can be studied with greater ease and accessibility. He and Dr. Paul Tchernia, his assistant director, put the finishing touches to the solution of the ancient riddle of why the Mediterranean doesn't overflow despite the current that rushes into the Straits of Gibraltar from the Atlantic.

The presence of an opposing undercurrent in the straits had long been known (and put to use during World War II by Italian submarines that rode it silently out into the Atlantic past British listening posts), but the Mediterranean's water budget was still uncertain. Using measurements obtained by ships of five nationalities, in a one-month survey of the straits, Lacombe and Tchernia concluded that about 31,600 cubic kilometres of water enter the Mediterranean from the Atlantic every year and only 30,000 slip out below. The missing five per cent represents evaporation by Mediterranean sunshine.

Despite the sun, Lacombe also finds the Mediterranean an ideal place to study the formation of deep water under "polar" conditions normally found only off the Greenland ice cap and Antarctica. During a cold European winter, the Mediterranean off the Riviera behaves almost like the Labrador Sea: surface water chilled by cold winds grows denser as it cools, then sinks to mix with underlying water and thus contributes to the formation of bottom water. What happens to it after that is of importance not only to physical oceanographers but to researchers in marine pollution who wish to know the fate of dangerous wastes buried in the deep.

Movements of bottom water are influenced by "sills" in the seabed, another feature that the Mediterranean offers in abundance for convenient examination. Lacombe told me of a study of the process of deep water formation in the north-west Mediterranean that he hopes to carry out with the participation of American, British and French vessels. Very detailed observations are to be made with new techniques to follow "mini-features" of temperature or salinity characteristics and to try to get at the underlying processes.

Lacombe served as chairman of the Intergovernmental Oceanographic Commission from 1965 to 1967. He manages to remain active in teaching and research, yet finds time for international affairs. It is something of an act of faith. He once wrote: "Will man be able to see the ocean's unity as an image of the need for a unity of efforts, a sharing by nations of their capacity for discovery so they can first explore and then exploit an area that is intrinsically almost entirely international and open to all—open to hopes but also to ambitions?"

AS chairman of the Commission, Lacombe was busy with legal matters. The status of buoys drifting or anchored in mid-ocean is a subject for discussion; so is freedom of research itself, which was set back, many feel, by the convention on the continental shelf. Under the convention, the country owning the shelf must give permission for research there, and scientists are complaining that it can take longer to get a permit than to do the work.

Lacombe sees two distinct viewpoints here: "The Americans and the British prefer to look at an issue case by case before trying to frame rules; the Soviets, and to some extent, the French and the Latin countries, want to study all aspects at once and move immediately to a convention."

The Commission has sixty member countries, but no budget of its own, no building and no bureaucracy. Administrative housekeeping arrangements are provided by Unesco at a cost of $50,000 to $80,000 a year, as compared to the $10 million to $20 million a year that the Commission's members have devoted to international co-operative expeditions.

The most recent of these expeditions is a study of the Kuroshio (its name means "black water" in Japanese), the western Pacific's equivalent of the Gulf Stream. It has been carried out by eight countries and thirty-six vessels, with Japan making the greatest contribution. In 1963 and 1964, an international co-operative investigation of the tropical Atlantic was conducted by the same number of nations using thirteen ships.

The Commission's largest single effort has been the International Indian Ocean Expedition from 1959 to 1965 that launched an armada of forty research vessels under fourteen flags, with nine more countries participating in shore operations.

On the oceanographers' charts, the Indian Ocean was one of the last great blanks; even data from commercial shipping had dwindled since the opening of the Suez Canal.

It was also the site of the kind of natural experiment that every physical oceanographer dreams of performing. To see the effect of the wind on the circulation of the sea, he would dearly love to switch it on and off. In the Indian Ocean, he has the seasonal reversal of the winds with the monsoons. Geologists wanted to learn if their ridge system continued into the Indian Ocean; biologists were interested in the actual productivity of an ocean that accounts for 25 per cent of the area of the sea but only 5 per cent of its fish catch.

No single nation could mount such an undertaking. The major oceanographic powers sent ships, but so did Australia, India, Indonesia, Pakistan, Portugal, South Africa and Thailand. The expedition was started by the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions, an organization that groups scientists in their professional capacities, not as delegates of governments.

Later on, the expedition was co-sponsored by SCOR and Unesco, while the Intergovernmental Oceanographic Commission took over its co-ordination. Its implications for weather and fisheries became the respective concerns of two U.N. agencies: the World Meteorological Organization, and the Food and Agriculture Organization.

Tangible results were produced by the free-roaming ships. The great wind experiment was a success. During the south-west summer monsoon, Soviet, British and American ships

investigated the Somali Current along the coasts of Arabia and Africa. It races north at speeds up to seven knots—almost twice as fast as the Gulf Stream.

The Somali Current turns sharply away from the Arabian coast. To replace it, cold water—55 degrees F., the coldest surface water anyone has ever found so close to the equator—rises and brings up nutrients. It is roughly the same upwelling situation that feeds the anchovies off Peru.

It would be comforting to write that a scientific expedition has found fish for the protein-hungry populations on the shores of the Arabian Sea. It would be misleading: the 150,000 tons of fish that are now being taken off the Arabian coast go into the holds of modern Japanese and Soviet trawlers. Antiquated local dhows are unable to work this new offshore fishery.

In the short run, therefore, the expedition has failed to achieve one of its stated purposes: to bring food out of the ocean for Asia. In the long run, the prospects may not be as gloomy. The expedition has given a salutary jolt to marine science in the region, mainly in India, which now has a National Institute of Oceanography of its own at New Delhi.

OTHER results of the expedition are being charted. Scripps Institution has brought out an atlas of the fishery oceanography of the Arabian Sea; Soviet scientists are responsible for a biological atlas of the entire Indian Ocean; Americans at the University of Hawaii are compiling physical and meteorological atlases.

Another heritage of the expedition is an International Meteorological Centre at Bombay that is getting an insight into the vagaries of the monsoon, upon which Indian agriculture depends. The end of the expedition has seen the start of permanent research in the Indian Ocean.

Scientific co-operation on the high seas is now focusing on areas that can be covered more intensively. The latest studies conducted by the Intergovernmental Oceanographic Commission are aimed at the Caribbean and the Mediterranean, two seas that have already been explored but now need to be understood.

What is heartening about both studies is that they give smaller countries a chance to join in oceanography. The investigation of the Caribbean was proposed by the Netherlands; research in the Mediterranean is bringing together countries of North Africa and the Near East under arrangements that permit them to carry out scientific investigations in the same waters.

Photo above shows an undersea geologist gathering samples from the seabed as clues to locating fossil-bearing oil beds. One day man may mine the sea floor for cobalt, copper and nickel, using huge vacuum cleaners to suck the minerals up into surface ships, or submarine earth movers to scrape them into submarine mine hoists.

GLACIERS ON THE MOVE

Scientists from many countries are studying the mystery of their periodic ebb and flow

Photo © APN

by Grigori Avsyuk and Vladimir Kotlyakov

GRIGORI AVSYUK *is assistant director of the Institute of Geography, U.S.S.R. Academy of Sciences. A corresponding member of the Academy, he is president of the Soviet Commission on Glaciology. Since 1956, he has directed Soviet studies on glaciology relating to the programme of the International Geophysical Year and other international projects. He has made a special study of glaciation in the Tien Shan mountains of Central Asia.*

VLADIMIR KOTLYAKOV *is director of glaciology studies at the Institute of Geography, U.S.S.R. Academy of Sciences. He has taken part in numerous expeditions to the Arctic and Antarctic, the Caucasus, and the Tien Shan and Pamir regions of Central Asia and is the author of several works on glaciology.*

WITH the advent of the Space Age, man has viewed his planet from afar for the first time and has marvelled at its beauty.

From a space capsule in orbit, the physical features of the globe are plainly visible. Vast plains and mountain ranges, the variegated patterns of deserts and steppes, taiga and jungle contrast sharply with the dazzling whiteness of the glaciers and the frozen ice covers of the Arctic and Antarctica. Even at a glance, an astronaut sees that much of the world is still locked in deep freeze.

Ice covers sixteen million square kilometres of the earth's surface (11 per cent of its total land area), and most of this expanse is occupied by the immense polar icecaps.

These frozen masses affect the circulation of the atmosphere and the ocean currents and strongly influence their thermal balance. By their action on the winds and waters, which give the earth its varied climatic and geographical zones, the giant icecaps thus serve as global "weather factories".

Several tens of thousands of years ago, ice covered 45 million square kilometres of the earth's surface. Climatic contrasts were greater and geographical zones moved towards the equator. But between each of the world's periods of glaciation there

RIVERS OF ICE. About one-tenth of the earth's surface is permanently covered by ice. Greenland and Antarctica lie capped by five million cubic miles of ice and snow. Mountain glaciers are widespread, ice covers vast expanses of the polar seas and permafrost (permanently frozen ground) occupies vast areas in the Northern Hemisphere. The study of the world's icebound areas, from the polar icecaps to the rivers of ice that creep down mountain slopes, is of concern not only to glaciologists, but to scientists and technologists in many other fields, since the ice areas are laboratories for the long-term study of climate, the water level of oceans and the past history of our planet. Photo shows the Alibek glacier in the northern Caucasus mountains, one of the regions in the U.S.S.R. where scientists are studying the mechanism of glacier fluctuation.

have been warmer ages, the interglacial phases. As these have lasted eight times longer than the ice ages, the absence of glaciers on the earth's surface is considered to be more characteristic of its normal state.

The last great Ice Age began about one million years ago during the Quaternary period. The rise of Man also dates from this glaciation following the appearance of his ape-men ancestors at the beginning of the Quaternary.

Man's development was accelerated by the advance of glaciers and ice sheets, as the drop in planetary temperatures forced him to master the mechanics of fire-making, to garb himself in warmer clothing and to build homes as protection against the cold.

In our own era, glaciers are receding, but the great icecap of Greenland and the frozen continent of Antarctica prove that we still live in a glacial age.

It has been said that glaciers are a negative phenomenon of nature, a global "malady", capable in certain circumstances of spreading rapidly. We do not share this view. Glaciers are a source of health to our planet since they help to shape climatic contrasts and thus the rich diversity of our global environment.

Moreover, they may eventually help to solve a major problem—the world water shortage. This becomes more acute each year as scientific and technological progress increases the need for fresh water. Scientists and engineers in many countries are therefore experimenting with ways to tap hitherto unused water resources. In this connexion the rational use of glaciers—vast untapped reservoirs of fresh water—deserves special consideration.

Another feature of glaciers is the special rôle they play in the natural cycle of our planet because of their ability to conserve water in solid form for very long periods. A snowflake which falls on a mountain glacier can "live" for 10,000 years before melting and becoming water again. This is quite a short lifetime compared to that

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Bearpaw glaciers

These twin glaciers are planted like the paws of a gigantic bear in the valley of Rhedin Fjord, Greenland (left glacier is featured on our cover). As much as four-fifths of Greenland is buried under an icecap that averages 1,000 feet in depth. Flowing from Greenland's icy mountains, glaciers discharge 1,000 million tons of ice into the sea every year—fragments that choke the waters with milky rubble and floating islands several miles long.

Photo © Ernst Hofer (from "Arktische Riviera", Ed. Kümmerly and Frey, Berne)

THE SAME SITE 100 YEARS APART

GLACIER IN RETREAT. Observation of glaciers in many parts of the world, particularly in the Alps and Scandinavia, shows they are receding. Between 1891 and 1965, with the exception of three years, more than half the Swiss glaciers observed were receding every year. In the early nineteenth century painting above, the artist was able to depict the famous Rhône glacier in Switzerland (source of the river which flows through France into the Mediterranean) as a mountainous wave of ice pouring out into the valley. As photo below taken at same site shows, it has since retreated considerably, and its mass is now trapped between two mountainsides.

Photos Swiss National Tourist Office, Zurich

of the ice mass in large glaciers. The "core" of those in Antarctica, for instance, is known to be 200,000 years old.

Almost 80 per cent of the world's fresh water—between 24 and 27 million cubic kilometres—is locked up in glaciers. The total volume is equal to the water flow of all the world's rivers for 700 years. Should this ice melt completely, the result would be a rise in the ocean level of 64 metres—enough to submerge the coastal regions of all continents over an area of about 15 million square kilometres.

Enough fresh water for man's present needs could be obtained by liquifying only a part of this enormous mass of "solid" water. Icebergs, for instance, could be used as water supplies for coastal cities.

Even a relatively small iceberg (two kilometres long, half a kilometre wide and 150 metres thick) contains about 150 million tons of water—enough to supply each person in a city of eight million inhabitants with 1,000 litres of water a day for a month. Towing the icebergs and tapping the water during the melting of large masses of ice would obviously present major technical problems, but theoretically the operation is feasible.

Similarly, glaciers in mountain ranges are a potential source of plentiful fresh water, particularly for use in irrigating the fertile but often arid plains that lie close to the foothills of mountain systems.

The glaciers of the Tien Shan mountains and the Pamirs in Central Asia, which border on fertile plains, contain about 2,000 cubic kilometres of ice. This represents nearly twice the amount of water currently used for irrigation throughout the world.

The first step in tapping at least part of our glacier water reserves is to find an effective way of melting ice rapidly. One solution is to cover the glacier with a dark powdery substance which helps to accelerate the melting process. This technique was used over two thousand years ago, in the time of Alexander the Great, by farmers in the Pamirs who spread earth and cinders on the snow to thaw out their fields more quickly.

Experiments on these lines in the Soviet Union and other countries have shown promising results, but the method will be more difficult to apply on a large scale because of the vagaries of the weather and the problem of transporting and spreading the melting agent.

To bring down a regular and adequate supply of water to the plains involves, on the one hand, retaining the snow on the mountain sides with screens, stockpiling snow in the foothills and producing artificial avalanches, and on the other, using techniques to melt the glaciers more quickly.

In this way a steady flow of meltwater into the rivers could be assured.

Photo USIS

A TORPEDO TO THE HEART

Vast Arctic ice shelves moving inexorably towards the sea "calve" giant-size icebergs (above) which often drift southwards with the currents. Despite radar, echo-sounders and airborne ice patrols, drifting icebergs still constitute a menace in the North Atlantic. Attacks on icebergs by bombing and shelling have had little effect, but a French scientist, Pierre-André Molène, proposed a method of placing an explosive in the core of an iceberg so that it can be blown apart (see drawing below). (1) A torpedo-shaped device is lowered by helicopter and burrows into the heart of the iceberg with the help of a heated nose cone. (2) A delayed action mechanism detonates the torpedo at the point where it will have the greatest effect. (3) Ship which serves as helicopter landing platform observes the effects of the explosion visually and with underwater shock wave detection apparatus (4).

In the spring and early summer, water could be obtained by melting reserves of snow, and towards the end of summer by a more intensive melting of glaciers. The operation would be made more effective by the installation of mountain reservoirs and water control systems.

It is still too early to say, however, whether melting operations could be carried out each year, since glacier water reserves are not unlimited.

With the development of technology, man penetrates more deeply into mountain areas. He discovers new seams of valuable minerals and untapped reserves of hydraulic power; he constructs motorways, pipelines and power lines. In the process, he invariably comes up against the dangers of snow and ice avalanches, mud streams and glaciers that advance with unexpected rapidity.

All mountainous countries in the temperate zone are exposed to the dangers of avalanches and sometimes

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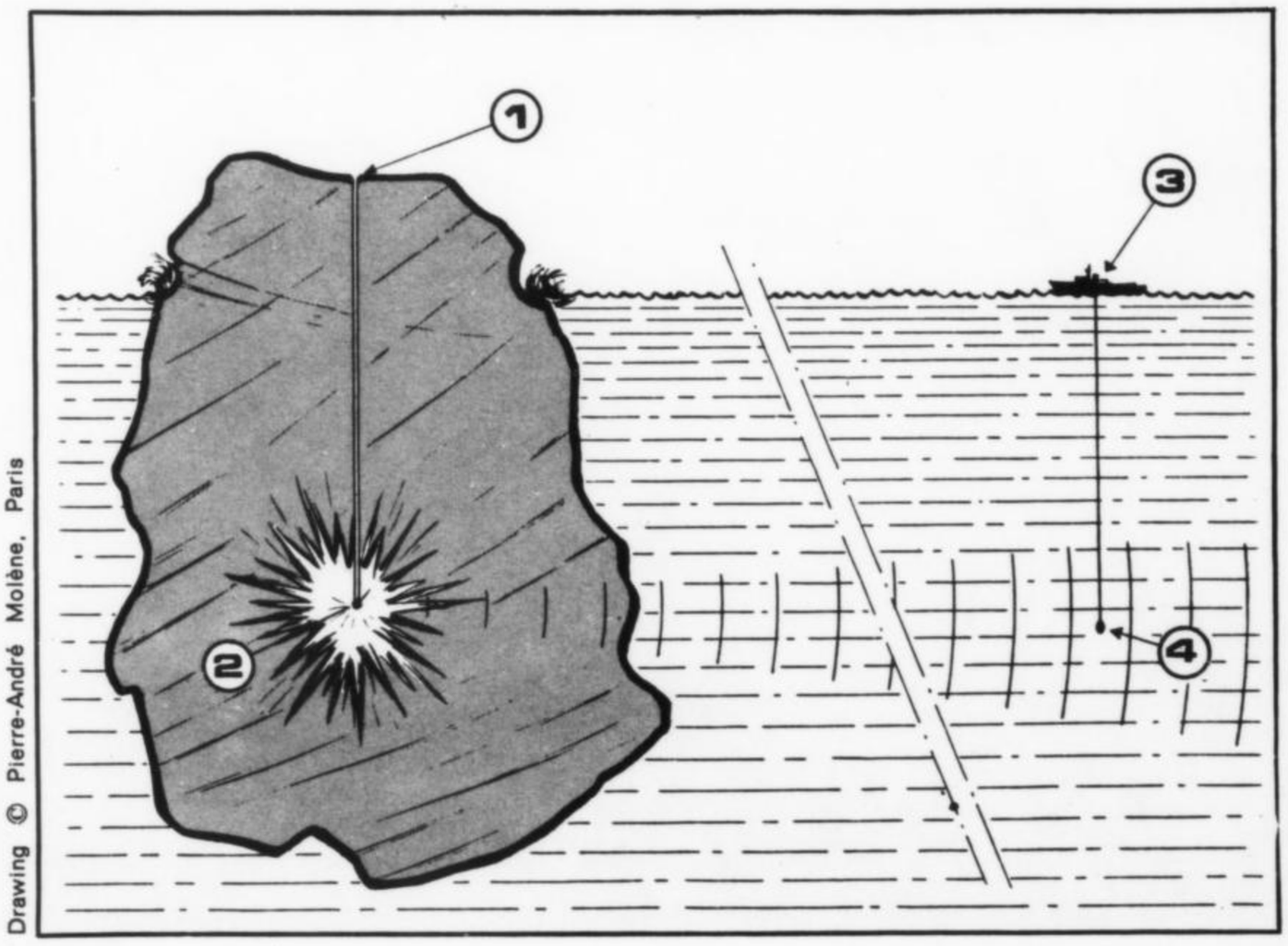

Drawing © Pierre-André Molène, Paris

THE ALASKAN EARTHQUAKE THAT SHOOK FIVE CONTINENTS

AT 5.36 p.m. on Good Friday, March 27, 1964, a devastating earthquake hit south-central Alaska, releasing in three to four minutes twice as much energy as the earthquake that destroyed San Francisco in 1906. One hundred and fifteen persons were killed in Alaska, $300 million worth of public and private property was destroyed, and the state's economy was crippled. The quake's magnitude, duration, and geographical scope rank it among the major earthquakes of history.

That the death toll was not many times higher was due to a happy combination of several chance elements: the sparse population, the fortuitous timing (the earthquake occurred on the evening of a holiday, when schools were empty and most offices deserted), a low tide, the absence of fire in residential and business areas, the generally mild weather, and the fact that it was the off season for fishing.

Since then, the Alaska earthquake has become the best documented and most thoroughly studied in history. Accurately described as a "natural scientific experiment on a grand scale," it has provided insights into a host of long standing scientific problems.

The first report in what will eventually be an eight-volume series on the earthquake has now been published by the U.S. National Academy of Sciences. With the overall title "The Great Alaska Earthquake of 1964," the series is intended to be a comprehensive report on the earthquake. Its volumes will cover in detail subjects in the natural sciences, engineering, and the social sciences.

The first volume, "Hydrology," (1) describes the effects of the earthquake on water in all its continental forms—on groundwater, on surface water, and on masses of snow and ice.

Most people do not associate water with earthquakes. But much of the epicentral region of the Alaska earthquake was covered with water in the form of snow and glaciers.

The hydrologic effects were spectacular: frozen lakes shattered, giant landslides spread over large glaciers, and snow avalanches plunged down steep mountain slopes. Human sig-

(1) "The Great Alaska Earthquake of 1964: Hydrology." Committee on the Alaska Earthquake of the Division of Earth Sciences, National Research Council, U.S.A., 1968. Text, 441 pp. illus.; with portfolio of 7 charts. $19.75. (Pub. 1603). Available from Printing & Publishing Office, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418, U.S.A.

Photo © Gene Daniels - Rapho, Paris

Awesome and little understood subterranean forces, straining at the earth's crust, erupted on March 27, 1964 to spread a 500 mile path of destruction through Alaska—the worst earthquake in North America since 1899. The main street of Anchorage (photo left) shows the capricious nature of the earthquake: the right side is a shambles, the left side remains intact. In places, buildings and pavements dropped 30 feet. Photo right shows pattern of earth fissures in residential area. In background are ruins of a new but unoccupied apartment building.

nificance, however, lies in the less spectacular: in the compaction of underground reservoirs, causing diminution of community water supplies; in the hazard of landslides in valleys once filled by glaciers but now occupied by man; and in the damage to lake shores and lake facilities.

This earthquake was the first such event known to have affected water levels in wells, aquifers (underground water beds), and rivers across a continent—indeed, across several continents. Fluctuations in water level were recorded in more than 700 wells in Africa, Asia, Australia, Europe, and North America. Seismic seiches (sudden oscillations of the water levels in lakes and streams) were recorded at more than 850 gauging stations in Australia and North America; nearly half of these latter occurrences were along the U.S. Gulf Coast. (This fact, the report said, suggests that a local earthquake along the Gulf Coast might cause more damage than one of the same magnitude anywhere else in the conterminous United States.)

Permanent changes in water level were observed and measured in many wells. Such effects have been suspected after previous earthquakes, but now for the first time the changes have been carefully documented.

Generally the amount of the change was found to depend on the total input of energy at the well site. Some wells in Alaska increased in level as much as five feet or decreased as much as fifteen feet; permanent changes outside Alaska are measured in hundredths of a foot. Not all wells in any one region were affected to the same extent, however. This variation in response has been fairly clearly related in some cases to porosity changes and compaction of aquifers in unconsolidated sediments.

The earthquake altered stream volume and water quality in places. It also brought down at least a year's expected quota of snow avalanches and a decade's quota of rockslides on to glaciers. Some 51 rock avalanches covering areas as large as a mile long and more than a quarter mile wide plunged on to many glaciers. The largest covered 4.4 square miles.

One the most spectacular (and most accessible for study) occurred on Sherman Glacier, 170 miles south-east of Anchorage and only seven miles from the Cordova, Alaska airport. Here, at least 13 million cubic yards of rock from two mountains fell on to the glacier, covering three square miles

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Photo © Marshall Lockman - Rapho

This stranded fishing boat, below, was swept onto the beach by a tsunami (seismic sea wave) created by the Alaska earthquake. Sometimes 30 feet high and travelling at 100 miles an hour, tsunamis surged ashore to batter coastal areas, flood towns and wreck port installations. The rugged beauty of the far north is captured in photo right of a moose making its way across an Alaskan lake.

Photo © Time-Life

of its surface with a layer of mixed rock debris and ice three to ten feet deep. That such a massive slide spread on to a glacier where nobody lives, notes the report, was a lucky accident.

An intensive study of this slide has been made, and a long-term study of its future effects on the glacier has been started. Already, it is clear, the shielding effect of the debris has changed the glacier from one shrinking in volume each year to one growing markedly in size. ,

The most startling aspect of the behaviour of avalanches triggered by the earthquake is probably their surprisingly great trajectory over long gentle slopes and even up reverse slopes as high as 490 feet. To explain the mechanics of sliding in these long trajectories, a novel theory has been proposed: that much of the motion took place over a cushion of compressed air trapped beneath the mass of rock and ice that came down. Although the scientific verdict is not yet complete on this theory, it could

Photo USIS

Avalanches racing uphill on cushions of air

explain why relatively soft surface snow was buried intact under the blanket and why some low bushes survived.

A possible alternative theory is lubrication on snow and ice. This is supported by the fact that the long avalanche paths were over glaciers and that at the time of the earthquake snow covered the areas of the slides.

In summarizing the effect of the earthquake on glaciers, the report notes that a negative conclusion is perhaps the most significant one. The enigma of rapid glacial surges, which occur only occasionally and during which glaciers move forward at rates of 10 to 150 feet a day, is still unsolved: but the Alaska earthquake has seemingly eliminated the "earthquake advance" theory which for years held that vast snow avalanches in the upper regions of a glacier during an earthquake caused changes in the glacier's mass balance, making it surge ahead for a few months.

Snow was abundant in southern Alaska on the day of the earthquake, but surprisingly few snow avalanches were caused, and no significant increase in glacier surges has followed in the critical areas, nor can any be detected in the making. Nevertheless, surges have gone on apace in random fashion since 1964.

Glacier fronts and ice-dammed lakes have shown surprisingly few immediate effects. The 25 tidal glaciers entering the sea near the earthquake's epicenter were "unperturbed." How little we actually know, says the report, is shown by the simple fact that the immediate effects on glaciers after the earthquake were far fewer and less conspicuous than had been expected.

All in all, the report notes, the hydrological effects of the earthquake were more a threat to the Alaska economy and to comfort than to lives. If the earthquake had been in a centre of broad-valley agriculture as in California or in an area of industrial concentration, the hydrological damage could have been a hundredfold greater.

The report suggests that a scientific task force be readied by an agency of the U. S. government to gather data and to make immediate studies within hours of the next major earthquake in the United States, and that a number of types of recording instruments be installed now in quake-prone areas to assist such studies. Some of these instruments, such as hydroseismic recorders in test wells and precise level gauges on lakes, might, the report observes, foretell an impending earthquake.

Another suggestion is that the forecasting of avalanches be extended to all seismically active valley areas and that signs showing danger levels for the day, similar to those warning of forest fire hazard, be posted on all major approaches to the areas.

Some of the major lessons to be drawn are those of zoning: which areas people should not inhabit (such as within two miles of an avalanche area) and where to build with caution, protection, or strength. It is foolhardy, the report states, to locate dwellings less than 10 feet above a large lake in a quake-prone area.

THE NON-ACCEPTANCE OF THE UNFAMILIAR

by Trân Van Khê

Photo © Max-Yves Brandily, Paris

TRAN VAN KHE, *seen here playing the* dàn tranh, *a 16-stringed Vietnamese instrument, comes from a family which has produced several generations of musicians. He is himself an accomplished musician in both western and eastern music. After studying medicine at the University of Hanoi, he devoted himself to musicology, and at the Sorbonne in Paris took his doctorate in Vietnamese music. He now teaches at the Institut de Musicologie de Paris, heads a music research team at the Centre National de la Recherche Scientifique (Paris), and directs the Vietnam section at the International Institute of Comparative Music Studies and Documentation (Berlin). He is also a member of the Unesco-sponsored International Music Council. He has written widely on musical questions and is the author of "Viêt-Nam" (published by Editions Buchet/ Chastel, Paris, 1967.)*

APART from a handful of western musicologists who have learned to understand and appreciate the different musical traditions of the East, and travellers who have spent many years in eastern countries, the western listener is usually puzzled by "eastern music".

Even Hector Berlioz, one of the world's great musicians, found it disconcerting. In 1851, while in London as France's official representative to the Universal Exhibition, he heard the performance of a Chinese air. Berlioz set down his impressions in a book he wrote three years later, "Les Soirées de l'Orchestre".

"The song, grotesque and horrible to a degree," he wrote, "ended, like any vulgar ballad, on the key-note; and never varied from the tonality and mode indicated at the outset. The accompaniment consisted of a rapid and monotonous rhythmic pattern executed on the mandolin (1), totally discordant with the notes sung."

Berlioz concluded with a severe stricture on Chinese and Indian music: "The Chinese and the Indians would have music like ours, if they had any at all; but in this domain they are plunged in the uttermost darkness of barbarity and childish ignorance, in which a few ineffective, groping aptitudes are barely perceptible. The peoples of the East call music what we would call a din; to them, as to the witches in Macbeth, 'Fair is foul, and foul is fair'."

And in his "A Travers Chants", he wrote: "The Chinese . . . sing as dogs yawn, or as cats throw up when they have swallowed a fish-bone."

It should not surprise us, therefore, to learn that an Indian musician of Lahore, according to H. Popley in "Music of India", described western music as "the howling of a jackal in a desert". A few years ago when I asked a teacher of musicology at the University of Madras, what he thought of the music of the West, he replied "It's noise!".

Mohammed Zerrouki, writing on Arab music in the "Revue Internationale de la Musique", has pictured the reactions of a person from an eastern country listening to western music.

"Accustomed as he is to monody, in which all the players perform in unison, as if they were all reciting the same poem, he is completely baffled by this criss-cross of conflicting and superimposed sounds. His distracted mind wanders from one musical phrase or instrument to another, in an attempt to understand what is going on.

"He sees a western orchestra as a group of musicians all babbling different languages. Each performer, completely independent, is free to express himself as he chooses. They all seem to turn their backs on each other, and a deaf ear as well. While the music is in full swing, some put down their instruments, leaving the

(1) Probably the p'ip'a, a pear-shaped lute with four strings.

Photo © Bill Homan - Camera Press

VARIATION ON A THEME. Although belonging to one of the traditional categories of Indian stringed instruments, the Vichitra Veena was developed only 100 years ago. Formed in the shape of a peacock whose tail is represented by the instrument's strings stretched over its neck, it has two spherical resonators. Very popular today, the Vichitra Veena plays an important part in Indian musical ensembles.

others to carry on; then realizing it is their turn, they frantically try to catch up on the rest. Above them, gesticulating wildly, is the conductor, whom no one seriously thinks of following" . . . "This, broadly speaking," says the writer, "is the inevitable reaction of an eastern listener who is completely uninitiated in European music."

Eastern and western listeners are generally unable to pass a valid judgement on music which is unfamiliar to them, for the reason that they base their opinion entirely on the artistic values and criteria applying to music in their own country or continent.

They also fail to appreciate the basic notions and principles governing music other than their own, and in particular, in the case of eastern traditions, the notions of scales,

CONTINUED ON PAGE 29

Photo © Bibliothèque Nationale, Paris

In the 19th century, the French composer Hector Berlioz breathed new life into harmony and enriched western music by expanding the expressiveness of wind instruments. But for most of his contempories, he was only a noise maker, as shown by this caricature of him conducting. Misunderstood genius that he was, Berlioz in turn could not understand the music of the East: he spoke of it with the same contempt as the neo-classicists mocked his work.

Photo © Pic, Paris

KOREAN HARMONIES

Traditional Korean music, which inherited its rules and forms from the music of China, has brought down to the present time the essence of an ancient musical art of the Orient. It is called "graceful music" (see also back cover) and is performed in its purest and most orthodox forms in Korea's Confucian temples. Played on traditional instruments, some of which were invented several centuries before our era, Korean music continues to figure prominently in secular and religious ceremonies. Above, an orchestra with stringed instruments placed in the foreground and bamboo flutes behind, plays a piece of "graceful music". Left, a dance traditionally performed by Buddhist nuns. The dancer provides a rhythmic accompaniment to her movements by striking the zua-go (a type of gong invented in China over 2,000 years ago) with sticks (below).

Photos © Max-Yves Brandily, Paris

modes, rhythm, the principles of instrumental and vocal execution, and aestnetic conceptions.

Yet music, whatever its origin, is basically the same everywhere. In the West as in the East, it is, as Jean-Jacques Rousseau put it, "the art of combining sounds in a manner agreeable to the ear." The *Yo-ki*, or Journal of Music, a major chapter in the Chinese book *Li ki* (The Journal of Rites), defines it as "an artistic combination of sounds."

Originally music was related to the image of a mythological god or supernatural being. The music played on the flute by the Indian god Krishna, or that composed by the legendary Chinese emperor Fou hi and played by Confucius on the Ch'in, had a semi-divine origin; so had the music of Orpheus, the prophet of Apollo, who with the strains of his lyre succeeded in taming wild animals.

Not only in China was the belief held that music had power, as the *Yo-ki* says, "to encourage the emulation of good examples, to deeply affect the emotions, change customs and transform morals and manners."

Marcel Belviannes, in "Sociologie de la Musique", writes that Plato believed music had a calming and moderating influence on human nature. According to Tseu Hia, the disciple of Confucius, quoted in the *Yo-ki*, "the songs of Cheng stimulated debauch and licentiousness; those of Song, womanizing and sloth; and those of Tsi, arrogance, depravity and overweening pride, and should be forbidden on ceremonial occasions."

Belviannes says that in Homer's view, "evil music and lascivious airs corrupt morals and weaken character." And according to the same author, Socrates proscribed "the effeminate music played at banquets, in the Ionian and Lydian modes, which he considered too flabby. He admitted only the Phrygian mode, as appropriately rendering the temper and virile accents of a warrior in the midst of the fray."

If we consider the form rather than the content of music, we are struck by the great variety of musical techniques and the differing conceptions of what is art. This is the cause of the mistaken judgements passed by the listener accustomed to one particular tradition, on music of other traditions.

A person from the West thinks that Indonesians sing out of tune because the intervals of the Indonesian *slendro* and *pelog* scales are quite different from those of the equally tempered scale. A musician in the Indonesian tradition judges a piano to be out of tune, since not one of its 88 keys exactly reproduces any of the notes in the *slendro* scale.

Even two Asian musicians, if they belong to different musical "families," are bound to disagree on the accuracy of scales. An Indonesian musician who once heard me play a piece of music in the *bac* mode of Viet Nam, transposed into the pentatonic scale *(do, re, fa, sol, la)*, said with a smile, "It's the *slendro* scale, but not quite in tune." This is understandable, since the *slendro* scale is theoretically obtained by dividing an octave into five equal intervals.

In this connexion it should be remembered that in a number of Far Eastern countries the limits within which a sound is considered to be in tune are very wide. Oscillations in pitch are often used for ornamental effect. A musical performance should not be considered out of tune merely because it does not exactly reproduce the notes of the equally tempered scale.

LET us suppose that a piece of music is played to an audience of musicians with different traditional musical backgrounds. The western musician tries to identify the tonality of the passage, project an underlying harmonic structure, trace a theme and its variations, and study rhythm and tempo; but not in the same way as would an Indian. Chinese, Japanese, Korean, and Vietnamese musicians are more interested in melodic line. An Indian listener will try to situate a passage in the framework of a given raga (melody-type), or attribute a modal feeling. Each member of the audience has his own listening habits, and judges a passage in the light of the criteria and rules typical of his own tradition.

The notions which serve as guidelines in fact vary considerably from one tradition to another. Alongside the equally tempered scale of western music are to be found countless other scales used in other countries. These include the five varieties of the Chinese pentatonic scale, the Japanese scales in the *ryo, ritsu, yo sempo* and *in sempo* modes, the Vietnamese scales in the *bac* and *nam* modes, and the modal scales of the music of India, Iran, and the Arab countries.

The major and minor modes of western music have their counterpart in hundreds of modes belonging to other traditions. For example there are the Chinese *tiao*, the Japanese

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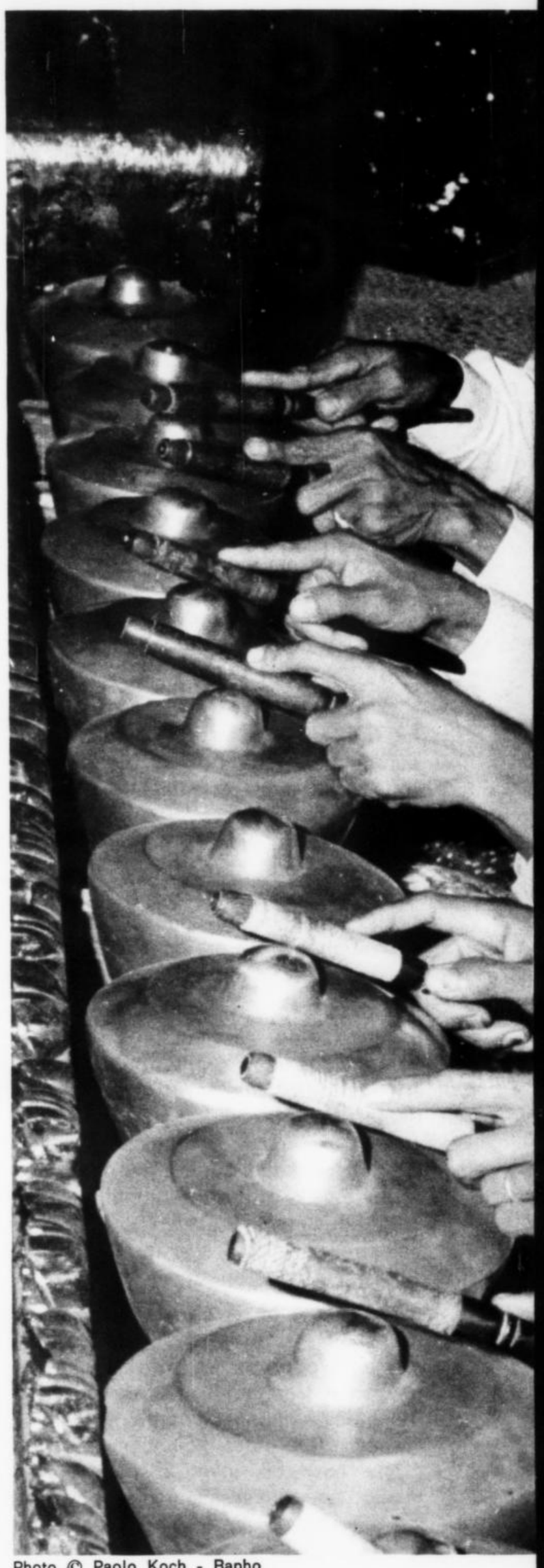


Photo © Paolo Koch - Rapho

Precision and skill in execution distinguishes a performance by the gamelan orchestra of Indonesia, which consists chiefly of percussion instruments of different pitches, and sometimes flutes or oboes. The orchestra, of varying size, is grouped to play a given theme in unison or at the octave, on which individual musicians can improvise variations.

To each tongue its own grammar

sempo, the Vietnamese *diêu*, the Indian *ragas*, the Iranian *dastgah*, and the Turkish and Arab *maqamat* modes.

Ornamental notes, which in the western tradition are considered simply as grace-notes superimposed on a given harmonic system, are an essential part of the Indian, Iranian, and Arab traditions. In Indian music an unornamented note is likened to "a moonless night, a garden without flowers, a river without water." In the Vietnamese tradition, set ornaments are one of the elements governing the mode.

While in the West a performer must not stray from his score, in India, Iran, and the Arab countries, improvisation is the rule; it is the musician's personal contribution during the actual performance.

In the West, one listens to music in the same way one looks at a cathedral. One begins by admiring the architecture, symmetry, and the balance, before passing on to the bas-reliefs. In the East, greater emphasis is placed from the outset on the most minor details; music is perceived aesthetically in the same way as one contemplates a Persian miniature.

Thus each tradition has its own particular way of creating, executing and listening to music. Aesthetic conceptions may be entirely different according to whether they are occidental or oriental. For example, a western audience finds falsetto grotesque, whereas it is highly appreciated by lovers of the traditional Chinese and Vietnamese theatre. Criticism of unfamiliar music should be made with the utmost circumspection.

In the age of jet planes and transistor radios, the western public has greater opportunities for listening to the great traditional masters of India, Iran, and Japan. Conversely, village homes in the most distant parts of the globe may be invaded by western music, broadcast daily by powerful radio stations. East and West meet much more frequently than in the past in the world of music; yet how many musicians, eastern or western, have been able to turn this to their advantage?

It must be admitted that most eastern musicians, dazzled by the technological and material civilization of the West, and by the "wealth" and "scientific" nature of western music, have learned to handle the musical idiom of the West, and have repudiated, despised or even abandoned their own musical heritage, of which they are often totally ignorant.

This may be acceptable where they acquire such a thorough knowledge of western music that they are capable of creating works whose merit is universally recognizable. Often however they produce hybrid music modelled on broadcast "pop" songs, contributing nothing to western culture and merely debasing their own music.

Frequently they try to "modernize" their traditional music by imposing a harmonic structure on basically melodic or modal music. This is the same kind of error a linguist would make were he to apply to his own language all the rules of English grammar, because he found them more practical.

IF only the younger generation of eastern musicians would make themselves more familiar with their own traditional music, before trying to renovate or modernize it on western lines. I strongly believe in preserving musical traditions, but "preservation" is not the same as conservatism or stagnation. I am all for progress, but "progress" does not necessarily mean westernization.

Westerners should get rid of the superior attitude that so many display, and try to understand music other than their own, which they are too often inclined to describe as "exotic" or to dismiss as "folk tunes."

A number of musicians, it is true, have looked to the East in their search for elements to renew their own musical language. Let us hope that they will succeed in capturing the spirit of eastern music, finding in it not a hybridization, but a wellspring which will richly nourish their own music.

While, as we have seen, similarities exist on the theoretical level between oriental and occidental music, this should not blind us to their fundamental differences. There can be no justification for criticizing unfamiliar music on the basis of criteria which are valid only for one's own tradition; nor for attempts to "modernize" one's own musical language by borrowing from foreign music elements which are totally out of keeping with it.

One of India's greatest figures, Rabindranath Tagore, defined the essential difference between the music of the Orient and of the Occident in these words:

"The world by day is like European music: a flowing concourse of vast harmony, composed of concord and discord... And the night world is our Indian music; one pure, deep and tender *raga*. They both stir us, yet the two are contradictory in spirit. But that cannot be helped. At the very root nature is divided into two, day and night, unity and variety, finite and infinite."

This does not mean that eastern music will forever be a closed book to the western public, or that western music cannot be understood in the East. But if Europeans are to enjoy the music of the East, and Asians to acquire a taste for western music, cultural exchanges will be needed as well as a period of initiation. As Romain Rolland wrote in "Jean-Christophe": "In spite of the claims made for it, music is not a universal language. Only the archery of words can pierce the heart of each of us with the arrow of sound."

African virtuoso

An oboe player of Chad. This type of oboe, varying only in size and form of decoration, is found throughout Islamic Africa. In numerous African villages, talented and often self-taught oboe players delight their friends and neighbours with traditional local melodies played, in many instances, on instruments of their own making. A remarkable oboe solo by a young boy from the Kanem area of Chad figures in a record entitled "Music of Chad (Kanem)", in the Unesco series "An Anthology of African Music" (see inside back cover).

Photo © Afrique Photo

GLACIERS ON THE MOVE *(Continued from page 17)*

of mud streams, against which costly protective works need to be raised. In the Soviet Union, a new technique was used in 1966 and 1967, when two powerful explosive charges were set off to create a protective barrage for the town of Alma Ata in the northern foothills of the Tien Shan mountains.

Equally dangerous are glaciers which suddenly advance at several hundred times their normal speed. Such movements occur in numerous regions of the globe, from Central Asia to Spitsbergen and Alaska. They are, indeed, so frequent that special studies should be undertaken to enable scientists to predict their possible effects. These movements are set off by processes at work within the glacier itself.

Geological and historical studies have revealed other features of glacier evolution. In the 10th and 11th centuries, large settlements grew up on the coasts of Greenland, whose inhabitants engaged in intensive cattle rearing. At that time, mountain glaciers in the Alps, the Caucasus, Scandinavia and Iceland had retreated, opening up many mountain passes.

But around the 14th and 15th centuries, glaciation of the northern seas increased; navigation to Greenland was interrupted, while in Iceland many ancient settlements were buried by glaciers. These changes were caused by glacial variations whose cycle occurs every 200 years or so.

Other glacial variations have shorter cycles which occur every 100, 22 or 11 years, and which some scientists attribute to periodical changes in solar activity. There is, however, an important mediator in the sun-glacier link—atmospheric circulation—which transforms variations in solar activity into changes in the behaviour of glaciers.

And though climatic variations during several centuries are synchronized with the evolution of glaciers over the planet as a whole, variations over a 10 to 20 year period may be more or less simultaneous only within particular regions. Observations over the last century show, for example, that 20 year cycle variations in the glaciers of Scandinavia occur inversely to such variations in the glaciers of the Alps and the Tien Shan mountains.

Variations in glacier activity affect the flow of rivers that rise in glacial regions as well as the reserves of "solid" water accumulated there. Thus, plans for economic development in these regions need to take into account long-term predictions of the behaviour of glaciers. Such predictions can be made only on the basis of comprehensive studies of the mechanism that causes the fluctuations of glaciers. This is a major task of modern glaciology—the science which studies glaciers and other types of natural ice.

Solution of this problem calls for the elaboration of a general theory on the fluctuations of glaciers, a task on which scientists in many countries, including the Soviet Union, are now engaged. The modern approach they are making to this problem is through systems of equations and mathematical modelling with the aid of computers. Solutions have already been found for the simpler types of glaciers, but we are far from resolving the problem as a whole.

Not all the laws governing the development of glaciers are known. It is still difficult to answer such questions as whether former glaciers can reappear in the present climate or what changes in the atmospheric circulation may be brought about by the partial disappearance of glaciers. Nor, at present, can we answer the vital question, "Is the world heading for a new Ice Age?".

IT is quite possible that in the lifetime of the present generation there will be a new advance of glaciers. During the last five to ten years, for example, glaciers in many mountain regions (the Caucasus, the Alps, Scandinavia, Alaska, Central Asia) show a tendency to advance.

But we should not regard this as a threat to the future of our planet. It may well be that glaciers, the natural refrigerators of the earth, will be absolutely indispensable to man in the future.

The climate of the earth is primarily conditioned by solar radiation. Yet already, the amount the energy used by man over large areas of industrially developed countries is almost equal to the amount of solar energy that reaches these areas. And if the production of man-made energy continues to increase at its present rate (almost 10 per cent per year), within a century it will exceed the energy we receive from the sun. That is why the advance of the glaciers could protect us from a different threat—the overheating of the planet.

If scientists are to foresee the effects of glaciation on the life of our planet, joint international research programmes need to be carried out in a number of fields—the use of snow and ice masses as additional sources of fresh water, forecasting sudden movements and variations in glaciers, the rôle of glaciers in the partial and overall water cycle in the world.

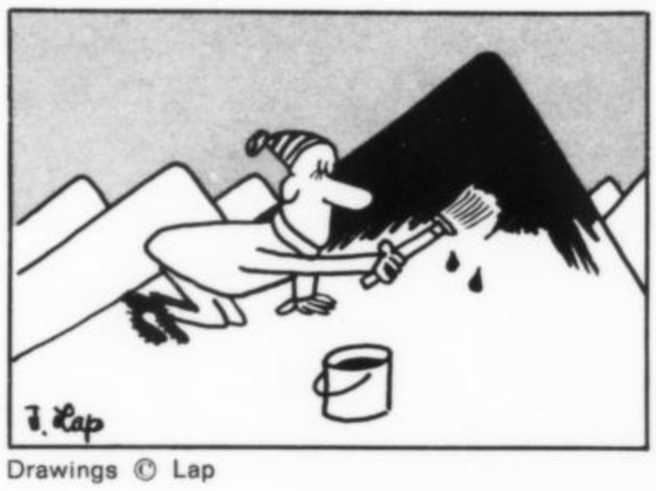
The first attempts to undertake such studies began ten years ago during the International Geophysical Year. The research lasted only two to three years which was clearly too short a time, since accurate predictions can be made only on the basis of long-term observations of glacier fluctuations.

That is why the study of glaciers —an important element in the water balance of the earth—has been included in the programme of the International Hydrological Decade organized by Unesco from 1965 to 1974. This research will have a direct impact on programmes for the rational utilization and conservation of natural resources, particularly in the developing countries of South America and Southern Asia where glaciers can be an important source of fresh water.

Glaciological research in the International Hydrological Decade relates to three major problems: the evaluation of polar ice and snow resources; permanent observation of the fluctuation of glaciers; studies of the balance of ice, water and heat in typical mountainous glacial basins.

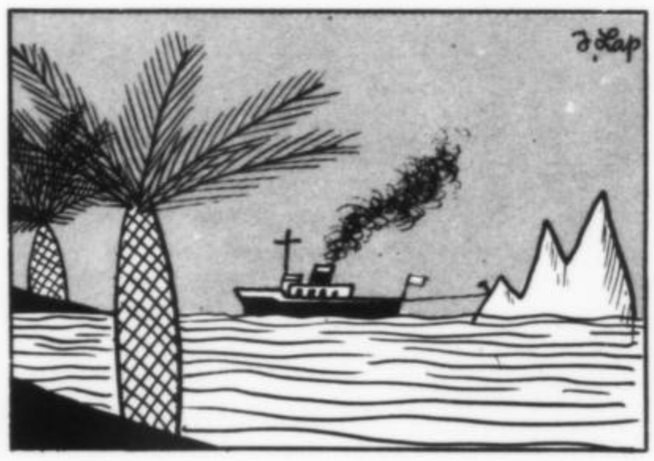
Soviet scientists are actively engaged in these programmes. They are compiling the first catalogue of glaciers in the U.S.S.R., a multi-volume work presenting data on the size, forms and locations of all the country's glaciers. The Soviet Union is also collaborating in the creation of a permanent international glacier service to collect data on glacier variations throughout the world. Studies are now being made on the mechanism of water flow from glaciers in seven experimental basins in the U.S.S.R. (three in the Caucasus, three in Central Asia and one in the Altai region).

Joint efforts by the world's glaciologists will enable man not only to predict the evolution of glaciers, but will eventually permit him to harness and utilize them as one of the natural resources of his planet.



Drawings © Lap

These two drawings were specially made for the "Unesco Courier" by French cartoonist Lap. Above, accelerating the melting rate of glaciers by covering them with a dark powder; below, towing an iceberg to a water-thirsty area.



Letters to the Editor

TOURIST TRIBULATIONS

Sir,

The U.N. General Assembly designated 1967 as "International Tourist Year". Has it been of some practical, worldwide benefit? Some countries have clearly confused "tourism" with certain endemic maladies that plague the world, if one is to judge by their determined efforts to stamp it out.

An exaggeration? Let me list the number of documents a foreigner living in one of the central African countries has to obtain if he wishes to visit a neighbouring country as a tourist: passport; foreign resident's identity card; identity card and authorization to leave the country issued by his own national embassy; international certificate of vaccination; receipts for payment of taxes and water and electricity bills; attestation that he has no police record; re-entry permit; national and international driving licences; automobile registration and insurance certificates; temporary vehicle export licence (including a deposit paid to the local authorities).

Sometimes he also needs an additional travel pass stamped by "authorities" with a somewhat doubtful official status. Finally he has to obtain a visa—not a simple matter when some neighbouring countries have no diplomatic representatives in his country of residence.

Sad to relate, such formalities and red tape are strictly applied. For instance, an attestation to the absence of a police record is delivered only in exchange for a record of the applicant's fingerprints.

After assembling this astonishing collection of documents and ensuring that their varying periods of validity cover the dates of the proposed holiday, and after the last stamp has been applied, the would-be tourist can hopefully set out on his journey.

A reader in central Africa

PRESERVING LAPP LANGUAGE AND CUSTOMS

Sir,

This letter is to fulfil a promise I made to a Laplander I visited at Västerbotten, Sweden, last year. Though an Assyriologist, I take a keen interest in the Lapps, their customs and language. These extremely likeable people are somewhat neglected nowadays and suffer as a result.

Per Bals, the Laplander with whom I had long talks, is an elderly man who has built up a museum singlehanded with everything he could collect on his people, their customs, implements and so on. He is now completing a comprehensive dictionary of the Lapp language comprising words, expressions, ways of pronunciation, etc. As far as I can judge, he has compiled it with great care, but I believe he is unable to raise enough money in his own country for its publication.

Can this be treated as an ethnic problem, as much as a linguistic one, transcending the national level, and possibly coming within the scope of Unesco's activities? Could something be done internationally to help the Lapps? And how can Per Bals be encouraged to continue his work? His address is: Per Bals, i Vilasunds Västerbotten, Sweden.

Dr. R. Ibard
Innsbruck, Austria

BLIND SPOT IN PLANETARY MANAGEMENT

Sir,

Bravo for your "planetary management" issue (January 1969). There seems, however, to be one very important blind spot in your coverage of the problems. How could a modern city function without a telephone directory and a central exchange? How could a factory function if no one knew the relationship between the activities of different departments? Although we have a fairly good estimate each year of the population breakdown of our Global City, we do not know how many organizations and other bodies there are (one to two million?), what they do, or how they interact. We live in a Global City with a thousand specialized, unplanned, out-of-date telephone directories to discourage us from trying to communicate and co-ordinate with other bodies, or manage the problems which particularly concern us. We cannot see the trees and shrubs, let alone the wood, because of our concentration on the leaves.

A.J.N. Judge
Brussels, Belgium

JUDGING MODERN JAPAN

Sir,

Your issue marking Japan's century of change since the Meiji Restoration (September-October 1968) did not show life in Japan or its people in true perspective. Few people in Japan today regard Emperor Meiji as the Father of Modern Japan because he was almost a puppet emperor backed up by nationalists and royalists of *Satsuma-Choshu han* (who set up the first central government). By the Constitution they themselves drew up they made almost a monarch of the emperor. Then in the name of *Ten-no* (the Emperor) they and their successors launched their notorious imperialistic policy.

One good feature of the policy was that it protected the country against colonialism, but their ultranationalism forced the people to become subservient to the State and later led Japan into a war of totalitarian aggression.

After the Second World War, we set up a democratic government, but the spirit of democracy is not yet rooted among us, and education in democratic principles is still imperfect. Individual human rights are often infringed and violated. We have only just started on this road.

Japanese civilization as seen by the world is not always representative of Japan's general social civilization. We have not yet reached the point from where we can judge or appraise modern Japan.

Yabe Masafumi
Tokyo, Japan

FULL OF SOUND AND FURY...

Sir,

I admire the exceedingly good quality of articles and photography in your magazine, but I object to the pusillanimous variety of letters in your correspondence page. These often reveal nothing of interest except the world-wide readership of the magazine. In most English newspapers or magazines letters published are usually of a strongly informative character or present rational arguments on topical ideological conflicts. I think you should pursue the same approach, or else use the space for further articles. Let the magazine speak for itself, which it can competently do.

Vincent Tickner
Brighton, U.K.

VENICE TODAY—AND TOMORROW

Sir,

"Is Venice condemned to collapse?" asked the German language edition of the "Unesco Courier", to which I subscribe, in its December 1968 issue.

To my way of thinking the answer to this question is the radical one of stopping off the sea flooding by sluice gates and the pumping out of the internal canal system, making Venice a normal city with dry roadways. Prior to filling in, the canal trench system would be provided with sanitational piping, electric power cables, etc. After a drying out period the foundations of the buildings might presumably be strengthened by pumping in cement.

The curse of Venice is water and the decay produced through damp. Anyone seeing what has happened to the Palazzo Garzoni (colour photo in your issue) since the start of this century can answer the plain question: "What's up with Venice?"—DAMP.

A.E. Southern
Birmingham, U.K.

Would it still be the Venice everyone loves? —Editor.

Sir,

Here is an imaginary view of Venice in the year 2001, "Venezia Futuristica," which I painted in 1966. It is now in a private art collection in Chicago, U.S.A.

Ludovico de Luigi
Venice, Italy

UNESCO NEWSROOM

Soviet prize to promote literacy

The Government of the Soviet Union has offered a prize of 5,000 roubles (about $5,000) for the promotion of Unesco's compaign against illiteracy. This was announced by Professor Serguei L. Tikhvinsky, representative of the U.S.S.R. on Unesco's Executive Board, at its meeting in Paris last month. The prize is to be called the Krupskaya Prize, after Nadjexda Krupskaya, widow of Lenin and a Vice-Minister of Education in the U.S.S.R. The Soviet Government is also offering 1,000,000 copy books for use in literacy work.

International aid for Borobudur

Unesco has received money and equipment totalling $22,000 to be used in the restoration and preservation of Borobudur in Java, one of the most important monuments of the Southern Hemisphere (See the "Unesco Courier", June 1968). The Netherlands has pledged $15,000 for preliminary surveys, Bremen (Fed. Rep. of Germany) is donating $3,000 for photographic documentation, and the JDR III Fund is contributing scientific instruments worth $4,000. The total cost of engineering and archaeological work to be done at Borobudur is estimated at $4 million.

The romance of water

The story of the world's creation, and of man, is to a great extent the story of water. This story is told in layman's terms in "The Romance of Water" by Herbert Wendt (see Bookshelf). The book covers oceanography, glaciology, the evolution and proliferation of life and the central rôle water has played in world history.

Unesco team to survey Acropolis

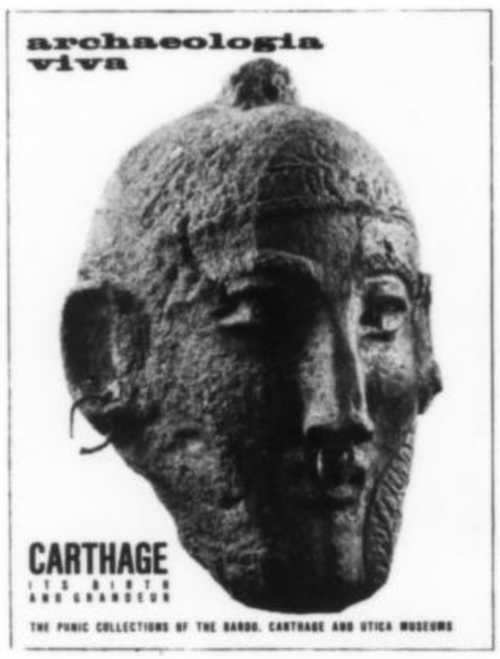
A Unesco team of specialists is to make a photogrammetrical survey of the Acropolis in Athens. The survey will help the Greek Antiquities Service to formulate plans for the conservation and restoration of monuments on the Acropolis (see the "Unesco Courier", June 1968), and for the integration of the site into development projects for central Athens.

'Paper' boat for Atlantic crossing

Thor Heyerdahl, the Norwegian explorer who led the Kon Tiki expedition on a 5,000 mile voyage by balsa wood raft across the South Pacific 22 years ago, plans to cross the Atlantic in a boat made of papyrus. He will sail with a crew of seven from Safi, Morocco and expects to land in Central America two to three months later. The boat, 45 ft. by 15 ft., will be a replica of the ancient Egyptian "paper vessels". Heyerdahl aims to show that people from ancient Mediterranean civilizations could have made the journey in similar boats, and that cultural imports from the Old World may thus have influenced Central American civilization.

Archaeologia Viva

A new international quarterly, entitled "Archaeologia Viva", published in France brings to the public at large as well as the expert perhaps the most original and luxuriously presented archaeology magazine available today. Sold chiefly by subscription, "Archaeologia Viva" contains a unique documentation written by leading international specialists and illustrations in colour and black and white on unfamiliar or little-known aspects of the world's archaeological treasures, much of it drawn from the reserves of the world's great



museums inaccessible to the public and from private collections. The first two issues deal with Iran and Tunisia (Carthage) respectively. Future issues will treat Lebanon, Cyprus, Afghanistan and Spain. For full information write to "Archaeologia Viva", 27 rue Saint-André-des-Arts, Paris 6e, France. (Annual subscription: U.K. £11.12.0; U.S.A. and Canada $27.50; single issues £3.8.0, $8.50).

Flashes...

■ *Industry in the developing countries of Asia grew 26 per cent between 1963 and 1967.*

■ *The importance of protecting the environment in industrial countries will be the theme of the joint Scandinavian pavilion at the World Exhibition in Osaka, Japan in 1970.*

■ *Europe's first poster museum, with 16,000 exhibits, has been opened near Warsaw, Poland.*

■ *Only two-fifths of school age children complete primary school in developing countries, reports Unicef.*

■ *A Centre for the Improvement and Demonstration of Olive Growing Techniques has been established in Cordoba, Spain by the U.N. and FAO. With 150 million trees, Spain is the world's major olive oil producer.*

Spacecraft fish-spotters

Spacecraft, using electronic sensors and photographic equipment to detect shoals of fish, could tell fishing vessels at sea where to cast their nets, says an FAO report. While orbiting the earth, a spacecraft spends three quarters of its time over oceans.

Red Cross League 214 million strong

This year, the 50th anniversary of its foundation, the League of Red Cross Societies embraces 111 national Red Cross, Red Crescent, and Red Lion and Sun Societies with a total membership of 214 million (one person out of every 12 in the world). The League was organized to link the different national societies which had grown from the original Red Cross movement founded in 1863 by Henri Dunant in Switzerland (see the "Unesco Courier", June 1963). As co-ordinating agency for international Red Cross activities, it is especially active in the fields of disaster relief, health and social services, nursing and youth work.

BOOKSHELF

■ **The Ageless Chinese**
(A History)
By Dun J. Li
J.M. Dent and Sons Ltd., London, 1968 (70/-stg.)

■ **The Puppets' Tale**
By Manik Bandkpadhyaya
Translated from the Bengali by Sachindralal Ghosh
Unesco's Translations Series (India).
Sahitya Akademi, New Delhi, 1968
(hard cover: Rs. 12; paperback: Rs. 7)

■ **Special Education in England and Wales**
(Second ed.)
By Stephen Jackson
Oxford University Press, London, 1969 (13/6 stg.)

■ **Bright Beacons**
By Mary M. Hutchinson and Pauline R. Brandon
Gaining Independence in Reading Series, prepared in co-operation with the Reading Institute of Boston, U.S.A.
Charles E. Merrill Publishing Company, Columbus, Ohio, 1968

■ **A Decade of Education in India**
By Prem Kirpal
Indian Book Company, Delhi, 1968
(Rs. 20.00)

■ **Carved Chinese Jades**
By S. Howard Hansford
New York Graphic Society Ltd., Greenwich, Conn., U.S.A., 1968
($16.50)

■ **The Romance of Water**
By Herbert Wendt
Translated by J.B.C. Grundy
J.M. Dent and Sons Ltd., London, 1969 (48/-stg.)

■ **Paris is Fun**
A Bilingual Guide
By Lory Alder
Pelham Books Ltd., London, 1969 (42/-stg.)

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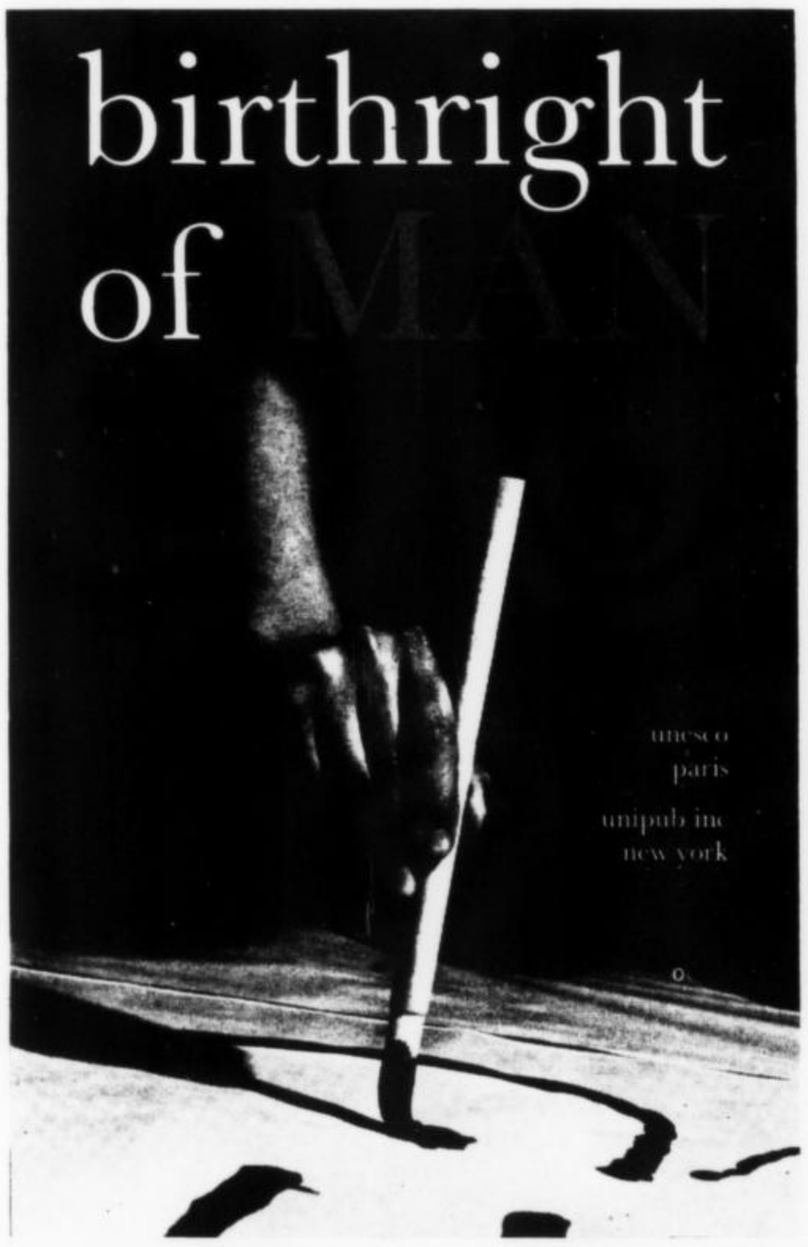

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GRACEFUL MUSIC OF KOREA

Beauty and goodness, the two cardinal virtues taught by Confucius, characterize the "graceful music" born in China more than 2,000 years ago and brought to Korea seven or eight centuries ago. The music has been handed down almost unchanged to the present day. Here, women musicians in Seoul play a traditional melody on the kayageum, a 12-stringed instrument made of paulownia wood (see article p. 26 and photo story p. 28).

Photo © Max-Yves Brandily, Paris